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ERRATA

Page 10, 10 lines from bottom of page—for "Sapota" read Saptona.

Pages 413-420, Anderson and Barlow's paper—unfortunately it has been necessary to omit the accent marks from most of the proper names in this paper.

Page 413, last line—for conquest read Conquest.

Page 413, last line of footnote 4—for Etudios read Estudios.

Page 414, footnote 5, lines 15, 20, 21, 28, 30—for I, read 1; line 33, for Nicholas read Nicolas.

Page 416, line 2—insert (?) after wooden.

Page 417, caption of fig. 2—for conquest read Conquest.

Page 418—italics for troxe, sementera, brazas.

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TAXONOMY OF CLEMATIS SECTION VIORNA[1]

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Introduction

The section Viorna of *Clematis* has received considerable attention from a number of authors, probably in part because of the attractive appearance of some of the species. Nevertheless there has been but one critical treatment of the group as a whole and there exists in the manuals and in the literature in general, a good deal of confusion with regard to many of the species. In the present study, the bibliographical problems involved have yielded to a systematic survey of the literature; the biological problems, of which there are several, for the most part remain, and they have been merely hinted at here.

History

In 1753, Linnaeus[2] described the then-known species of *Clematis* under two genera, *Clematis* and *Atragene,* the latter group being distinguished principally by its possession of petaloid staminodia. This delimitation of the genera was adopted generally by the followers of Linnaeus' sexual system.

DeCandolle,[3] in 1818, extended *Clematis* to include three of the four species which Linnaeus included under *Atragene,* and proposed a new genus, *Naravelia,* to accommodate the single remaining Linnaean species, *Atragene zeylanica.* DeCandolle's delimitation of *Clematis* has been followed almost universally, although a number of generic segregates were proposed between the time of Linnaéus and 1842. Only *Viorna* and *Viticella* have received recognition, having been used,

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[1] An investigation carried out in the Graduate Laboratory of the Henry Shaw School of Botany of Washington University and submitted as a thesis in partial fulfillment of the requirements for the degree of master of science in the Henry Shaw School of Botany of Washington University; subsequently revised and enlarged.

[2] Linnaeus, Sp. Pl. 543. 1753.

[3] DeCandolle, Syst. 1:131-168. 1818; and Prodr. 1:2-10. 1824.

[1] Issued March 22, 1943.

together with *Atragene* and *Clematis*, by such American botanists as Britton, Small, and Rydberg.

Two species of the section Viorna were known to Linnaeus, and were described by him as *Clematis Viorna* and *C. crispa*. With the description of *C. reticulata* by Walter in 1788, and *C. ochroleuca* by Aiton in 1789, the more important of the eastern species were known. In 1814, Pursh described *C. hirsutissima* from a specimen collected by Lewis and Clark on their return from the Pacific Coast, a species which was rediscovered by Douglas in 1826, and named *C. Douglasii*. Two more entities were added to the section in 1838 with the description by Torrey and Gray of *C. Baldwinii* and *C. Pitcheri*. In 1853, the handsome *C. texensis* came to the attention of Gray, but was unfortunately described by him as the variety *coccinea* of *C. Viorna*. The collections of Dr. Bigelow during the Pacific Railway explorations of 1853 disclosed *C. Bigelovii*. In 1875, *C. Fremontii*, which had been collected by Fremont as early as 1843, was rediscovered and described. Several species from the southeastern states were published in the period between 1890 and 1903, most of which are attributable to Small, and descriptions of occasional new species have appeared from time to time since then.

Account has been given above only of the more important species of the section and their valid description. A large number of names was added to the synonymy by European authors who described American species without an understanding of their range of variation, and sometimes without a knowledge of the bibliography. *C. crispa* and *C. Pitcheri* have suffered particularly on this score, each of them having been described repeatedly as new species, and even having been confused with each other. Many of the names proposed by European authors were based on cultivated material, and it is possible that some of the plants described, in the 'Botanical Magazine,' for instance, were spontaneous hybrids of horticultural origin. Another source of synonymy has been floras of the western states, such as those of Porter, Rydberg, Heller and others.

The first author to recognize the section Viorna as a separate entity was Spach,[4] who in 1839 proposed the genus *Viorna* to include the species here referred to as *C. crispa*, *C. Viorna* and *C. integrifolia*. Earlier writers, including Torrey and Gray,[5] had for the most part followed Linnaeus in artificially dividing *Clematis* into Scandentes and Erectae, or equivalent groups. The first critical treatment of any of the species of the section was Gray's[6] review of the climbing species in 1881. James' revision of the genus *Clematis*,[7] is little more than a compilation of descriptions, and Kuntze's monograph[8] is completely unacceptable, at least as far as its treatment of the species of this section is concerned, and has burdened some of the species with a cumbersome synonymy. In 1895, the group appeared for the first time as the section Viorna of the genus *Clematis* in the

[4] Spach, Hist. Nat. Vég. Phan. 7:268-272. 1839.
[5] Torrey & Gray, Fl. N. Am. 1:7-11. 1838.
[6] Gray in Bot. Mag., *pl.* 6594. 1881.
[7] James in Jour. Cincin. Soc. Nat. Hist. 6:118-135. 1883.
[8] Kuntze in Verh. Bot. Ver. Brandenb. 26:83-202. 1885.

'Synoptical Flora.'[9] Here Gray's review of 1881 was incorporated in somewhat modified form, but expanded to include the whole genus. To date, it is the only satisfactory monographic treatment which VIORNA has received.

Since the appearance of the 'Synoptical Flora,' the most important departure has been Small's[10] recognition of VIORNA as a genus, in which he has been followed by Britton and Brown[11] and a number of other botanists. Finally should be mentioned Wherry's[12] review of *C. ochroleuca* and its near relatives, which rectifies a nomenclatorial mix-up of long standing.

In this paper, the section VIORNA is divided into five subsections, which include 18 species and five varieties, as indicated in the following outline:

Clematis section **Viorna**

Subsection 1. EUVIORNAE

1. *C. Viorna*
1a. *C. Viorna* var. *flaccida*
2. *C. Gattingeri*

3. *C. Addisonii*
4. *C. glaucophylla*
5. *C. versicolor*
6. *C. texensis*

7. *C. reticulata*
8. *C. Beadlei*
9. *C. Pitcheri*
9a. *C. Pitcheri* var. *filifera*

Subsection 2. VITICELLAE

10. *C. crispa*

Subsection 3. INTEGRIFOLIAE

11. *C. ochroleuca*
12. *C. albicoma*
13. *C. viticaulis*
14. *C. Fremontii*
14a. *C. Fremontii* var. *Riehlii*

Subsection 4. BALDWINIANAE

15. *C. Baldwinii*

Subsection 5. HIRSUTISSIMAE

16. *C. hirsutissima*
16a. *C. hirsutissima* var. *Scottii*
16b. *C. hirsutissima* var. *arizonica*
17. *C. Palmeri*
18. *C. Bigelovii*

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[9] Gray, Syn. Fl. N. Am. **1**:58. 1895.
[10] Small, Fl. Southeast. U. S. 437-439. 1903.
[11] Britton & Brown, Ill. Fl., ed. 2, **2**:122-126. 1913.
[12] Wherry in Jour. Wash. Acad. Sci. **21**:194-198. 1931.

Morphological Features of Taxonomic Value

Caudex and Roots.—The species of the section Viorna are herbaceous perennial vines or erect suffrutescent plants. The persisting structure is a woody caudex with a mass of apparently unbranched fleshy roots, in the cortex of which is stored a great deal of starch. Growth in the spring is from lateral buds in the apical region of the caudex. There is apparently little propagation of the plants by branching of underground structures.

Neither the caudex nor roots furnished any feature of value in distinguishing species, and the fact that these parts are rarely collected makes them valueless in dealing with herbarium specimens.

Stem.—The stem of both the erect species and the vines is usually 6-angled or 6–12-ribbed, and usually quite woody, at least in age. The stem is brittle, breaking in such a way that the "bark" is separated from the wood. Usually the stem is red. In general, it offers poor taxonomic characters, though such features as pubescence, color, angularity and degree of branching are of some value.

Leaves.—Many useful characters are found in the leaves. They are decussately opposite, the petioles somewhat clasping to form a stipular (?) collar about the node. They vary from simple and entire in the subsection Integrifoliae to multifid in *C. hirsutissima,* or pinnate-ternate in many species of the subsection Euviornae. The degree of compounding is useful in distinguishing many of the species, but it must be used with judgment, since leaves on adjacent plants, or on the same plant, may vary considerably in this character. Also a good deal of variation may be expected in different parts of the geographical range of a single species, as in *C. Pitcheri* and *C. hirsutissima.*

The leaflets of the pinnate leaves of the Euviornae show a marked reduction in size from the base to the tip of each leaf. The distal pair of leaflets is usually very minute, and in place of a terminal leaflet there is usually a tendril-like process. This has been called a tendril by many authors, and indeed it looks very much like one, but it does not appear to be tactile. The twining is by the petiolules of the leaflets or by the rachises. This structure is characteristic of all the climbing species of the section Viorna, and hence is not of specific value but may be used in characterizing subsections.

Reticulate venation of the leaves is a valuable character. It is not possible to distinguish degrees of reticulation consistently, but lack of reticulation may be contrasted with more or less strong reticulation, and when used in this way the character is a constant one. Glaucousness of the leaves characterizes four species of the Euviornae. Little attention has been paid to degrees of pubescence of the leaves. Shape of leaves or leaflets is reliable only in the most general way; particularly is this so of the tips. Characters concerned with the aspect of the leaves, involving such details as proportion of blade to petiolar and rachis tissue, geniculation of the rachis, ascending or drooping attitude, etc., would be valuable if such characters could be put into words.

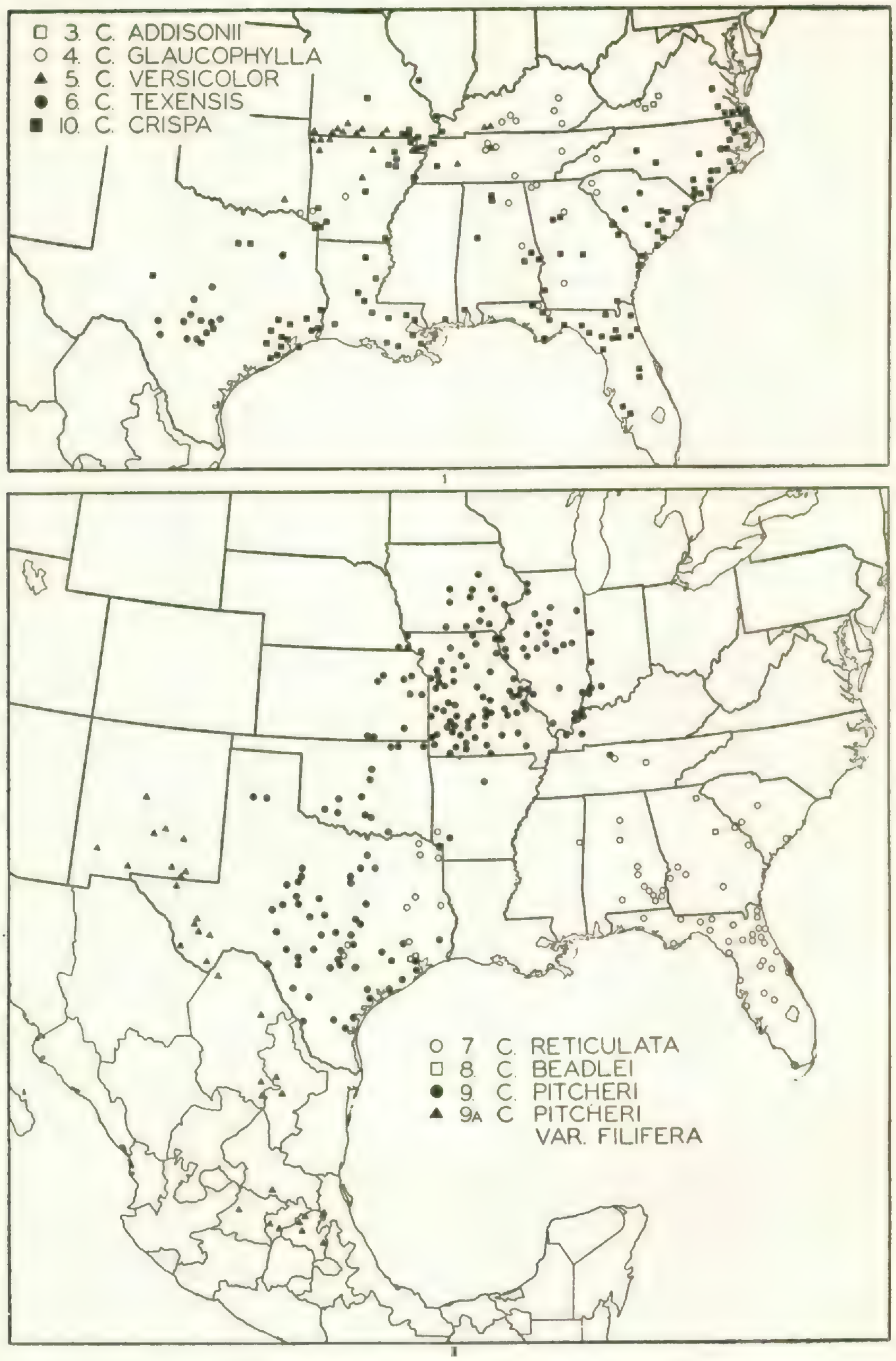
INFLORESCENCE.—In the species of the subsections HIRSUTISSIMAE, BALDWINIANAE and INTEGRIFOLIAE, and sometimes in *C. crispa*, the flowers are solitary at the tips of branches and borne on pedicels which are not subtended by bracts or specialized floral leaves. In these species, therefore, it is not proper to speak of an inflorescence. In the EUVIORNAE, however, the flowers are solitary or in few-flowered cymose inflorescences, on axillary peduncles. Each flower of the cyme is subtended by a pair of simple leaves which usually simulate the leaflets of the compound leaves. Vegetative branches originate in the axillary position just as do inflorescences, and the lowermost pair of leaves of a vegetative branch is simple, corresponding so closely in every detail to the simple leaves of an inflorescence that there is no doubt of their homology. For this reason the writer has preferred to use the term "floral leaves" rather than "bracts" for the leaves of the inflorescence.

These details of the inflorescence, as has been implied, are typical of the EUVIORNAE and can be used in characterizing the subsection. In specific delimitation, however, little use can be made of inflorescence characters.

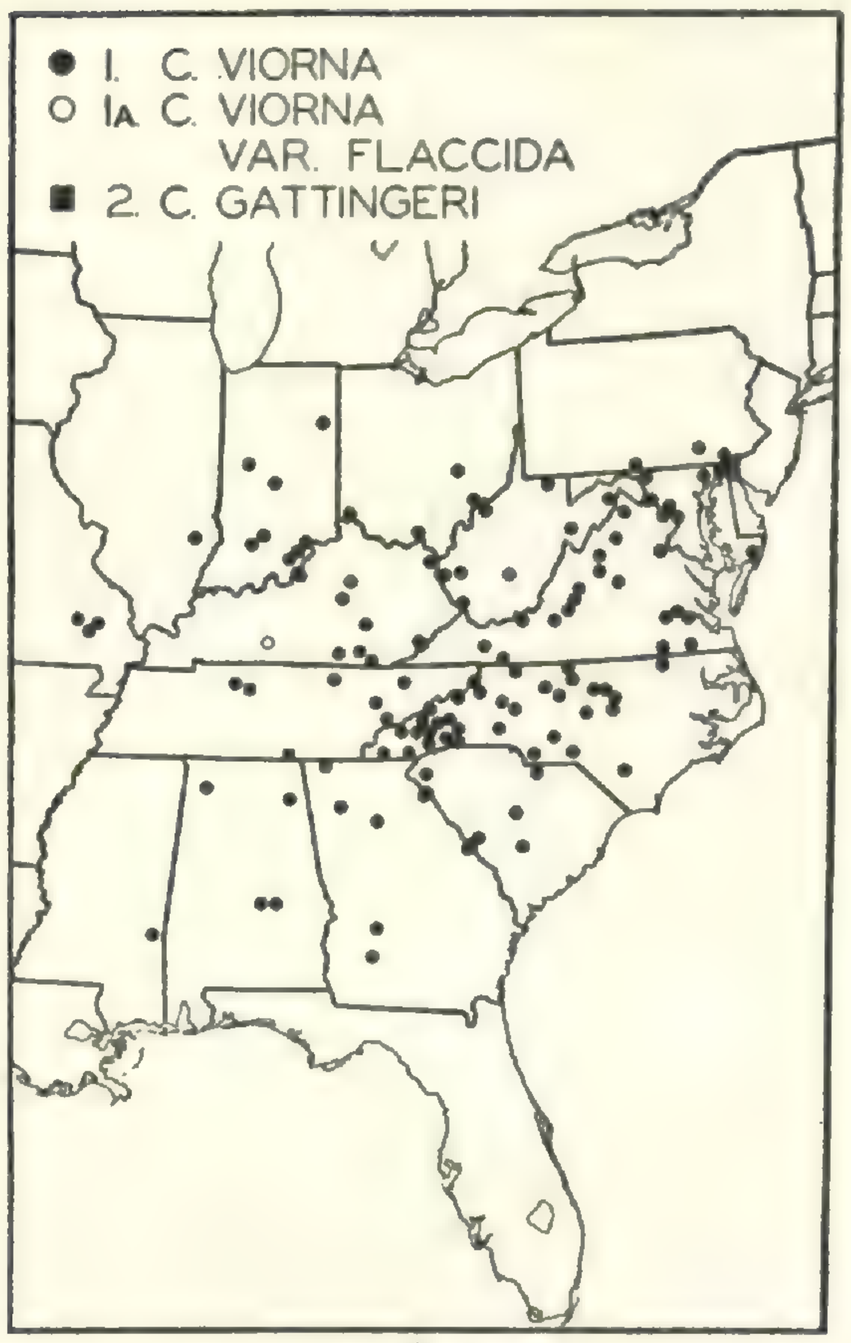
Flowers.—The flowers should be expected to provide some of the most valuable characters. However, in herbarium specimens, to which this study has been almost entirely confined, not only is color lost, but, because of the large size of the flowers, shape is invariably distorted. For instance, the sepals are characteristically ribbed in several species, but no hint of this can be found in the dried specimens. Furthermore, since most of the specimens have few flowers, it has not seemed advisable to dissect flowers in any quantity, and stamen characters, for example, have been omitted from consideration. Nevertheless, certain features of the sepals have been utilized. Pubescence of the outer surface, or the lack of it, is characteristic and constant in most species. The width of the expanded valvate margins is a characteristic feature of several species, notably *C. crispa*. The shape of the sepals, and particularly their length in relation to the body of stamens, have value.

Achenes.—The achenes consist of a flat, roughly orbicular "achene-body," and the elongated persistent style, which is here referred to as the "achene-tail." The achene-body has a depression on either side which marks the location of the flat, albuminous seed. This depressed central portion is surrounded in most species by a conspicuous "rim," which consists largely of cork. The thickness and width of the rim are of use, particularly in delimiting the subsections. In shape, the achene-bodies vary to some extent from individual to individual, and also within a single fruiting head, depending apparently on how much they are crowded during development. With these considerations in mind, the shape of the achene-body is a useful character. Other characters which are of some use are its size and its pubescence.

The plumose achene-tails of most of the species are among their most striking characters. The length of the tails is of some value. The way in which they are



Figs. 1–2. Distribution of species of *Clematis* section VIORNA.



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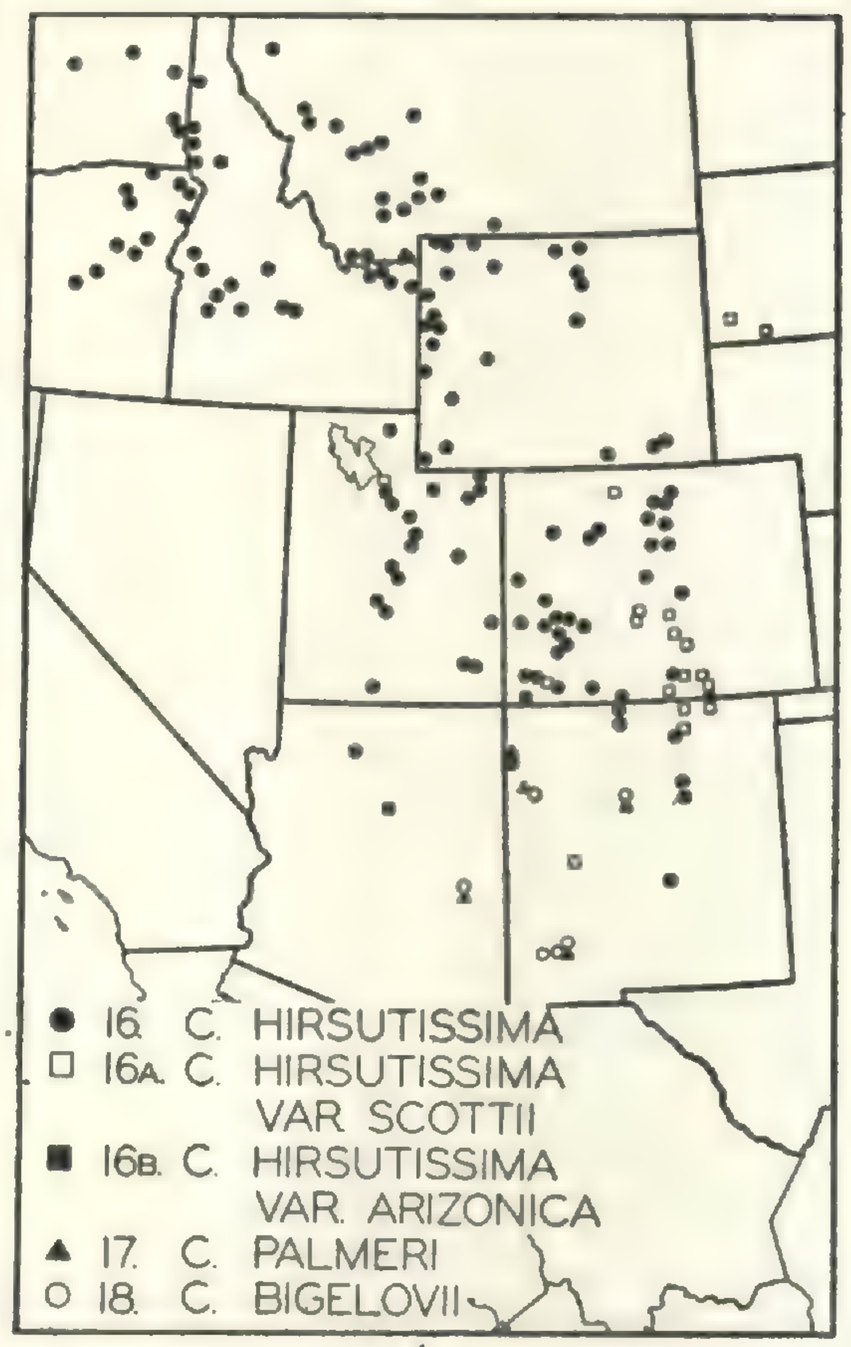

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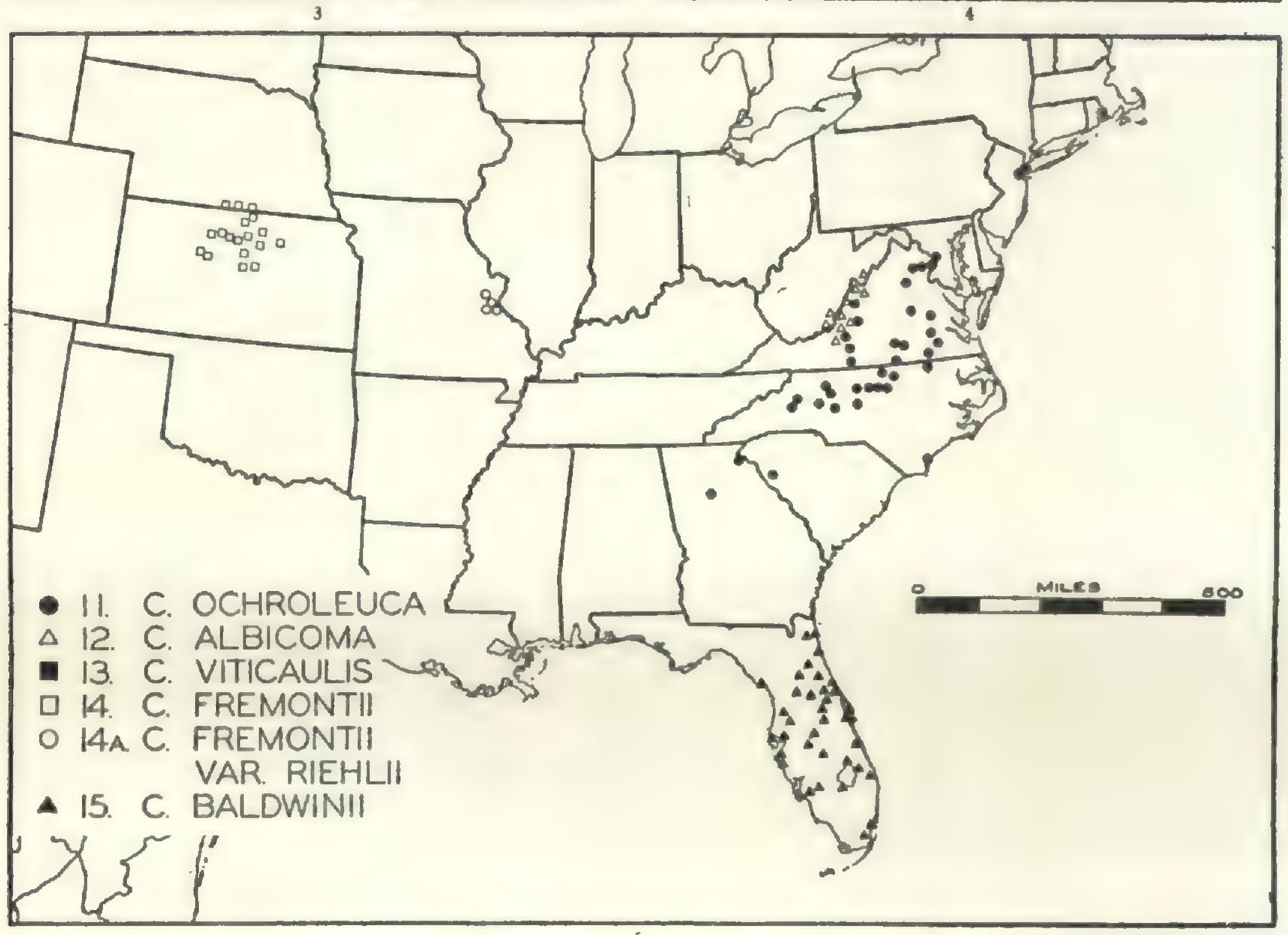

5

Figs. 3–5. Distribution of species of *Clematis* section VIORNA.

intertwined to form a spherical head, on the one hand, or a spreading mass, on the other, should be a useful character, but this is often distorted in herbarium specimens. The color of the plumose hairs is not very constant in most species, but it has been used in characterizing *C. albicoma,* where it appears constant. The plumosity of the achene-tails is most useful where a distinction can be based on its presence or absence.

Distribution

The geographical range of the species of the section Viorna embraces all of the United States except the New England and north-central states, Nevada and California. One variety occurs in Mexico. With the exception of the subsection Hirsutissimae, they are principally plants of the central and southern states. No general statement can be made about their habitat. *C. crispa* is a native of swamps; most of the Euviornae are to be found in fairly moist situations along creeks, along the edges of moist woods, at mouths of caves, etc., although *C. Pitcheri* occurs in rather dry prairie habitats as well as in woodlands; *C. albicoma, C. viticaulis* and *C. Fremontii* are all restricted to rocky barrens; *C. Baldwinii* occurs in the sandy pine woods of Florida; and *C. hirsutissima* is a spring flower, mainly of the shrub zone in the Rockies.

A discussion of possible centers of distribution is beyond the writer's present knowledge, but the following general remarks can be made, supplementing the distributional data given below in the discussion of each species.

The Hirsutissimae are largely confined to the Rocky Mountain region, although they occur to some extent in adjacent areas, such as the Columbia Plateau, the Colorado Plateau, the Black Hills and Badlands of South Dakota. *C. Baldwinii* is entirely restricted to peninsular Florida. The species of the subsection Integrifoliae are, with the exception of *C. ochroleuca,* very limited in their geographical range, suggesting strongly that they represent relict forms. Within the subsection Euviornae there are indications of centers of distribution in the southern Appalachian region, in the Ozark region, on the Edwards Plateau, and for *C. Pitcheri,* perhaps also in the mountains of central Mexico, but a detailed discussion of this topic is premature. There are entities in this subsection, too, whose distribution is very limited, particularly the peculiar *C. Addisonii,* which occurs in a restricted region about Roanoke, Virginia. The distribution of *C. crispa* corresponds very nicely with the outline of the Atlantic and Gulf Costal Plain as defined by Fenneman.[13]

The base maps on which the distributions of the various species are plotted were obtained from the Bureau of Agricultural Economics of the U. S. Department of Agriculture. The imperfections of a distribution map based on herbarium records should be recognized; this point is discussed by Pennell.[14] In this paper,

[13] Fenneman, Physiography of Eastern U. S., *pl.* 3. 1938.
[14] Pennell, Scrophulariaceae of Eastern Temperate N. Am., 542-544. 1935.

all the records at the writer's disposal were plotted, as far as was possible without allowing the symbols (which measure about 15 miles in diameter) to overlap.

Generic and Specific Concept

It is generally agreed that the American species of *Clematis* fall into three more or less natural groups, whether these are regarded as sections of the genus *Clematis* as they are here, or as distinct genera. The section Viorna is distinguished from the section Flammula by its lack of a paniculate inflorescence, its large leathery sepals, and its lack of a tendency toward dioecism; and from the section Atragene by its lack of petaloid staminodia and by the leathery texture of its erect sepals. Other differences can be pointed out. On the whole, the three groups are so distinct, at least when the American species alone are considered, that the question of their possible generic rank deserves serious consideration. But the sections Atragene and Flammula have very close relatives in Eurasia. Rarely have any Eurasian species been referred to the section (or genus) Viorna, but it is the writer's opinion that the European *C. Viticella* and *C. integrifolia* should be included in this section because of their resemblance to *C. crispa* and *C. ochroleuca* respectively; and the section should be extended to embrace *C. fusca* of the Kamchatka Peninsula. If this is done the problem arises of what to do with such Chinese species as *C. Henryi,* which have Viorna-like flowers but produce winter buds on their perennial woody stems, and with *C. lanuginosa,* also of China, which appears to be but one step removed from *C. Viticella.* Such considerations have compelled the writer to define Viorna conservatively as a section of *Clematis* rather than as a genus in its own right. Furthermore, the author's knowledge of *Clematis* as a whole is not sufficient to rule out the existence of intermediates between Viorna and the other American sections of the genus.

The section Viorna, as here treated, does not appear to be a wholly natural one, although the subsections here described are believed to be so. In particular, the subsection Hirsutissimae seems to be comparatively distant in its relationship to the rest of the section, possibly deserving of separate sectional rank. But in this matter, as in that of the possible generic rank of Viorna, the author has preferred to follow the conservative course and to reserve any sectional changes until a survey of the entire genus *Clematis* may be made.

Aside from *Naravelia,* which is obviously closely related to *Clematis* and could well be lumped with it, *Clematis* is quite distinct from other Ranunculaceous genera. It is most closely related to *Anemone;* the marked resemblance between *C. hirsutissima* and members of the Pulsatilla section of *Anemone* points to a common ancestry. *C. hirsutissima,* nevertheless, cannot be regarded as congeneric with the species of the section Pulsatilla.

In delimiting the entities within this section, an effort has been made to maintain the species as groups which are not merely morphologically different but which are *discrete* entities. This emphasis on discreteness, while it could not be followed with complete consistency, has led to the recognition, on the one hand,

of several large species, particularly *C. Pitcheri,* of wide geographical range and great morphological diversity; and, on the other hand, of species and varieties such as *C. Fremontii* var. *Riehlii,* which is separated from the species proper on the basis of rather tenuous differences in size and leaf-shape, but differences which are constant and well supported by geographic isolation. The writer believes that the very different sorts of species which have resulted are not due to inconsistency on his part, but rather that they are, to some extent at least, an expression of a real biological difference in the nature of the groups.

Cytology

Previous to Gregory's[15] cytological study of the Ranunculaceae, there were no published chromosome counts for any species of the section Viorna. Gregory gives $n = 8$ or $2n = 16$ for *C. Addisonii, C. texensis, C. crispa, C. ochroleuca, C. Fremontii, C. hirsutissima* and *C. hirsutissima* var. *Scottii.* The writer has found $n = 8$ in *C. Pitcheri, C. versicolor* and *C. Fremontii* var. *Riehlii.* Chromosome numbers of about 30 other species of *Clematis* have been reported, and in these the haploid number is eight with only three exceptions (all cultivated). These data seem to indicate that *Clematis* is one of those genera in which ploidy is rare. Chromosome numbers, in other words, may be expected to be the same throughout the genus, and therefore would be of no significance in interpreting the phylogeny of the group.

Nevertheless, the section appears to be a suitable group for a systematic cytological study, since the chromosomes are relatively large and comparatively few, and there are no serious technical difficulties. Such a study would be expected to throw light upon the relationships of the species, though it would have to go considerably further than a mere counting of the chromosomes.

Economic Value

The crushed leaves of certain European species of *Clematis* have been used as a vesicant. The leaves and other plant parts of the Viorna species also appear to contain an irritating principle. Geyer[16] gives an account of the use of the roots of *C. hirsutissima* by the "Sapota" Indians to stimulate their exhausted horses. Dried and powdered leaves of the same species were used as a snuff by Indians of the Northwest, according to a note on a herbarium label. The Seminole Indians of Florida are said to have used a decoction of the roots of *C. Baldwinii* as a remedy for sunstroke.

Some of the species of the section Viorna have ornamental value, although they cannot compare in showiness with the large-flowered hybrids typified by "C. Jackmani," nor in profusion of bloom with the many small-flowered species such as *C. Vitalba, C. paniculata,* etc. Their value lies in the curiousness of their urn-shaped flowers. Species of this section will rarely be found planted outside botan-

[15] Gregory in Trans. Am. Phil. Soc., n. s. **31**:466-468. 1941.
[16] Geyer in Lond. Jour. Bot. **5**:301. 1846.

ical gardens or the gardens of a few discriminating amateurs. Two species are planted more frequently than any others: *C. crispa,* which is distinguished by its broadly winged and undulate sepals, and the red-flowered *C. texensis*. However, other species would seem to have horticultural value, and they have had a champion in the late J. E. Spingarn.[17]

The real horticultural value of these plants, however, will probably be not their use as they are, but rather their employment in the breeding of hybrid varieties. *C. texensis* has been crossed with several of the large-flowered varieties to produce handsome hybrids such as "Countess of Onslow" and "Duchess of Albany."[18] It is probable that other hybrids, utilizing this and other species of the section, will appear in the future.

Acknowledgments

Acknowledgments are due Dr. George T. Moore for necessary library and herbarium facilities; Dr. J. M. Greenman for his invaluable guidance and interest throughout the course of this investigation; and a number of associates and correspondents who have contributed material, data or suggestions.

Materials

The specimens examined in the course of this study total over 2,000 numbers, embracing nearly all of the material deposited in the larger American herbaria. The institutions at which the herbaria are located, and the abbreviations by which they are referred to in the citations, are:

AA—Arnold Arboretum of Harvard University, Jamaica Plain, Massachusetts.
DU—Duke University, Durham, North Carolina.
FLA—Florida Agricultural Experiment Station, Gainesville, Florida.
FM—Field Museum of Natural History, Chicago, Illinois.
G—Gray Herbarium of Harvard University, Cambridge, Mass.
KS—Kansas State Agricultural College, Manhattan, Kansas.
MBG—Missouri Botanical Garden, St. Louis, Missouri.
ND—University of Notre Dame, Notre Dame, Indiana.
NEB—University of Nebraska, Lincoln, Nebraska.
NY—New York Botanical Garden, Bronx Park, New York City.
PA—Academy of Natural Sciences, Philadelphia, Pennsylvania.
POM—Pomona College, Claremont, California.
RM—Rocky Mountain Herbarium, University of Wyoming, Laramie, Wyoming.
TAM—Texas Agricultural Experiment Station, College Station, Texas.
TEX—University of Texas, Austin, Texas.
UM—University of Minnesota, Minneapolis, Minnesota.
UP—University of Pennsylvania, Philadelphia, Pennsylvania.
US—United States National Museum, Washington, D. C.

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[17] Spingarn in Nat. Hort. Mag. 13:76-95. 1934.
[18] Spingarn in Jour. N. Y. Bot. Gard. 37:153-158. 1936.

Type material has been seen for practically all of the species which have been described, excepting only some of the earliest, whose type specimens are in European herbaria. However, these species have for the most part been well understood for many years, and the possibility of misinterpretation is slight.

The author's field experience with *Clematis* is very limited, and he is keenly aware of this fact.

TAXONOMY

Clematis L. Sp. Pl. 543. 1753.

Clematis section **Viorna**[19] Gray, Syn. Fl. N. Am. **1**:5. 1895; Gray, Man., ed. 7. 403. 1908.

Viorna[20] Reich. Handb. 277. 1837; Spach, Hist. Nat. Vég. Phan. **7**:268. 1839; Small, Fl. Southeast. U. S. 437. 1903; Rydb. Fl. Rocky Mts. 291. 1917; Rydb. Fl. Prair. & Plains, 335. 1932; Small, Man. Southeast. Fl. 526. 1933.

Clematis section *Urnigerae* Lavallée, Clem. 47. 1884.

Herbaceous perennial vines which climb by twining of the petiolules; or erect suffrutescent herbs. Leaves simple or variously compound. Flowers large, perfect, solitary and terminal, or in 1–few-flowered axillary cymose inflorescences, mostly nodding. Sepals 4 (exceptionally 5 or 6), thick or thickish, some shade of blue, red or purple, erect, valvate, connivent for most of their length, slightly spreading to strongly recurved at the apex. Achene-bodies compressed, usually more or less conspicuously rimmed. Achene-tails usually plumose, but sometimes merely pubescent, or naked. Type species of section: *Clematis Viorna* L. Sp. Pl. 543. 1753.

ARTIFICIAL KEY TO SPECIES AND VARIETIES

A. Climbing or ascending plants, usually with twining petiolules.
  B. Leaves glaucous.
    C. Leaves pinnate-ternate, the leaflets 3 cm. or less long, lobed, ovate, round-tipped ..... *18. C. Bigelovii*
  CC. Leaves pinnate or somewhat pinnate-ternate, the leaflets, at least some of them, more than 5 cm. long; leaves sometimes simple.
    D. Leaves not conspicuously reticulate-veined.
      E. Ascending; many of the leaves simple, compound leaves 4–6-foliolate; leaflets simple, only one pair large ..... *3. C. Addisonii*
      EE. Climbing; compound leaves 8–10-foliolate; leaflets often ternate ..... *4. C. glaucophylla*
    DD. Leaves reticulate-veined.

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[19] *Viorna* is apparently the Latinized form of the French *viorne,* which is derived from the Latin *Viburnum.* In France, *viorne* applies to a species of *Viburnum* as well as to *Clematis Vitalba.* Linnaeus, for some unexplained reason, applied the specific epithet *Viorna* to the American species which forms the type of this section.

[20] Reichenbach listed *Viorna* as a genus of the *Clematideae* without description, but with Persoon as authority. In his Syn. Pl. 2:98. 1809, Persoon treats *Viorna* as a section or subsection of *Atragene* for a reason which is hard to understand. It appears, then, that Spach, in the work cited above, was the first to use *Viorna* in its modern sense.

E. Flowers red; leaflet tips blunt, rounded or emarginate ..... *6. C. texensis*
EE. Flowers lavender or greenish; leaflet tips acute to rounded, not emarginate ..... *5. C. versicolor*

BB. Leaves not glaucous.
C. Leaves more or less strongly reticulate-veined.
D. Achene-tails plumose.
E. Leaflets coriaceous, extremely strongly and closely reticulate-veined, more or less round-tipped ..... *7. C. reticulata*
EE. Leaflets thinner, more finely and distantly reticulate-veined, tips acute to acuminate ..... *8. C. Beadlei*
DD. Achene-tails glabrous to long silky-pubescent, but not plumose.
E. Leaves usually pinnate; leaflets 4–10 cm. long; sepals usually ovate, without a margin to moderately margined ..... *9. C. Pitcheri*
EE. Leaves usually pinnate-ternate; leaflets mostly 4 cm. long or less; sepals lanceolate, moderately margined ..... *9a. C. Pitcheri* var. *filifera*
CC. Leaves not conspicuously reticulate-veined.
D. Sepals with wide, undulate or crisped margins; achene-tails pubescent, not plumose ..... *10. C. crispa*
DD. Sepals without a margin or narrow-margined; achene-tails plumose.
E. Flowers small, less than 15 mm. long; leaves pinnate, the larger leaflets 5–8 cm. long, densely soft-pubescent below ..... *2. C. Gattingeri*
EE. Flowers considerably larger; leaves pinnate to pinnate-ternate, leaflets larger.
F. Leaves pinnate; leaflets simple, entire, large, extremely thin, densely velvety-pubescent below ..... *1a. C. Viorna* var. *flaccida*
FF. Leaves pinnate to pinnate-ternate; leaflets not extremely thin nor densely pubescent below ..... *1. C. Viorna*

AA. Plants erect, not climbing.
B. All the leaves simple and broad, entire or rarely coarsely toothed.
C. Leaves glaucous ..... *3. C. Addisonii*
CC. Leaves not glaucous.
D. Plants stout; achene-tails glabrous or nearly so.
E. Plants 1.5–4.0 dm. high; leaves ovate to obicular ..... *14. C. Fremontii*
EE. Plants 2.5–7.0 dm. high; leaves elliptic-lanceolate to elliptic-ovate ..... *14a. C. Fremontii* var. *Riehlii*
DD. Plants more slender; achene-tails conspicuously plumose.
E. Plants profusely branched; leaves lanceolate, less than 6 cm. long; sepals glabrous; achene-tails reddish-brown ..... *13. C. viticaulis*
EE. Plants less branched; leaves ovate, at least some of them more than 6 cm. long; sepals pubescent; achene-tails usually lighter in color.
F. Plants simple or few-branched, more or less pubescent, achene-tails light yellowish-brown to tawny ..... *11. C. ochroleuca*
FF. Plants usually much branched, often white silky-pubescent throughout; achene-tails whitish or pale yellow ..... *12. C. albicoma*

BB. Leaves variously lobed, divided, pinnate, pinnatifid, or, if simple, distinctly linear or narrowly lanceolate.
C. Achene-tails glabrous or pubescent, not plumose ..... *18. C. Bigelovii*
CC. Achene-tails plumose.
D. Plants extremely slender, glabrous or slightly pubescent; restricted to peninsular Florida ..... *15. C. Baldwinii*
DD. Plants somewhat more stout, densely pubescent, at least in youth; native to the western states.
E. Leaves pinnate, the leaflets simple or lobed, lanceolate, distinctly petioluled ..... *16a. C. hirsutissima* var. *Scottii*
EE. Leaves, at least some of them, pinnate-ternate, 2–3-pinnatifid, or multifid, the leaflets various.

F. Leaves mostly pinnate-ternate, the leaflets lobed or coarsely toothed, ovate, 3–7 cm. long ..... *17. C. Palmeri*

FF. Leaves 2–3-pinnatifid or multifid, slightly pubescent to densely hirsute, ultimate divisions narrow.

G. Ultimate divisions of the leaves linear, at least 2 mm. broad ..... *16. C. hirsutissima*

GG. Ultimate divisions of the leaves filiform, about 1 mm. broad ..... *16b. C. hirsutissima* var. *arizonica*

Subsection 1. Euviornae

Somewhat woody vines (except *C. Addisonii*, which is bushy.) Leaves pinnate or pinnate-ternate, terminating in a tendril-like filament; petiolules and leaf-rachises twining. Flowers borne on 1–few-flowered axillary peduncles, nodding, more or less ovoid. Sepals thick, erect, connivent for most of their length, margins lacking or narrowly expanded toward the tips. Achene-bodies relatively large, strongly compressed, with prominent rims. Achene-tails plumose (in *C. Pitcheri* naked or merely pubescent.) Spp. 1-9a.

1. Clematis Viorna L. Sp. Pl. 543. 1753; Gray in Bot. Mag. *pl. 6594.* 1881; James in Jour. Cincin. Soc. Nat. Hist. 6:121. 1883; Kuntze in Verh. Bot. Ver. Brandenb. 26:133. 1885, in part; Gray, Syn. Fl. N. Am. 1:5. 1895; Britt. & Br. Ill. Fl. 2:69. 1897; Britt. Man. 422. 1901; Gray, Man. ed. 7, 403. 1908.

Viorna urnigera Spach, Hist. Nat. Vég. Phan. 7:270. 1839.

C. Viorna γ. *normalis* Kuntze in Verh. Bot. Ver. Brandenb. 26:133. 1885.

V. Viorna Small, Fl. Southeast. U. S. 439, 1331. 1903; Britt. & Br. Ill. Fl. ed. 2, 2:124, 1913; Small, Man. Southeast. Fl. 528. 1933.

V. Ridgwayi Standl. in Smithson. Misc. Coll. 56^{34}:2, *pl. 1.* 1912; Britt. & Br. Ill. Fl., ed. 2. 2:124. 1913.

Stem slender, 6-angled, pilose at least below the nodes; cauline leaves pinnate with 3–4 pairs of divisions, the terminal pair usually minute, leaves ending in a slender tendril-like filament; leaf-divisions simple, 3-lobed or 3-foliolate, with petiolules one-third to one-half their length; leaflets ovate, acute to acuminate, entire, thin, indistinctly 3–5-veined, not reticulate-veined, more or less pilose below; peduncles axillary, 1–7-flowered; floral leaves simple or rarely 3-lobed, subsessile, approximating the cauline leaflets in size and character; flowers nodding, more or less ovoid, 1.5–2.5 cm. or less in length; sepals ovate, usually with slender terete wooly tips which are convolute in the bud, equalling or slightly exceeding the stamens, thick, smooth, short appressed-pubescent, margins white-tomentose, not expanded; peduncles in fruit erect; achene-bodies suborbicular to elliptic, 3–6 mm. broad, conspicuously rimmed, closely appressed-pubescent; achene-tails plumose, light yellow or brownish, spreading or loosely coiled.

Distribution: on wooded river banks and in similar habitats, in the Piedmont and mountain regions from southern Pennsylvania to northern Mississippi, and from Ohio west to southern Missouri.

Pennsylvania.—chester co.: Landenberg, 25 May 1930 & 18 June 1931, *Stone* (PA). franklin co.: Mercersburg, 1850, *Porter* (G). lancaster co.: Conestoga,

June 1887, and Mountville, July 1889, *Eby* (MBG); Conestoga Creek, July 1890, *Eby* (US).

DELAWARE.—NEW CASTLE CO.: Aug. 1863, *Canby* (FM); Mill Creek, 11 July 1896, *Canby* (US), and 17 July 1897 (PA); Pike Creek, Aug. 1902, *Canby* (G); Mt. Cuba, 10 July 1871, *Commons* (NY, PA, US), 14 July 1871 (G, MBG), and 2 July 1873 (PA); Mill Creek, *Commons 6* (UM), and *Long 28285* (PA); Wilmington, *Tatnall* (NY), Red Clay Creek, 2 July 1927 (UP), and Ashland, *1856* (G); Mt. Cuba, 24 June 1906, *Van Pelt* (PA); Ashland, 29 June 1924, *Williams* (G, NY, PA); Mt. Cuba, 24 June 1906, *Williamson* (NY).

MARYLAND.—CECIL CO.: Leslie Station, 28 June 1891, *Brinton* (UP), and 20 June 1892, *Crawford* (PA). HARFORD CO.: Broad Creek, *Tidestrom 7190* (DU). MONTGOMERY CO.: s. e. of Great Falls, *Chase 2311* (FM); Great Falls, *Hermann 10380* (MBG, NY); Glen Echo, *House 820* (MBG), and Plummers Island, *1089* (NY); Cabin John, *Smith 3071* (G); canal opposite Great Falls, *Van Eseltine & Moseley 107* (US); island at Great Falls, 29 May 1909, *Williamson* (PA). WASHINGTON CO.: n. w. of Sandy Hook, 5 June 1934, *Wherry* (UP). WORCESTER CO.: Snow Hill, *Moldenke 4192* (NY).

DISTRICT OF COLUMBIA.—*Canby* (NY); 19 June 1877, *Chickering* (UM); May 1896, *Morris* (UM); Chain Bridge, *Pennell 2481* (PA); 5 & 27 June 1896, *Steele* (MBG), and 27 June & 16 July 1897 (G, UM); 3 June 1877 & 17 July 1881, *Ward* (G).

VIRGINIA.—ALBEMARLE CO.: Woodridge, *Tidestrom 7203* (US). ARLINGTON CO.: Ft. Meyer, 10 June 1893, *Blodgett* (NY); Chain Bridge to Cabin John Bridge, *Morris 116* (FM); Potomac River, *Zumbrock* (FM). AUGUSTA CO.: Waynesboro, *Pursh* (PA). BEDFORD CO.: 1 July & 10 Aug. 1868, *Curtiss* (FM), 1 July 1871 (G, MBG, NY), and 1 July & 12 Aug. 1872 (FM, ND); Peaks of Otter, *Palmer 38, 38a* (US), and *Rydberg 9236* (NY, PA). DINWIDDIE CO.: Petersburg, *Fernald & Long 12078* (G), and Apr. 1903, *Prior* (US). FAIRFAX CO.: Great Falls, 14 July 1874, *Carter* (PA), *Pennell 2507* (PA), *Seamans* (NY), and *Wismer 520* (DU, UP). FREDERICK CO.: Middletown, *Griscom & Hunnewell 18829* (G). GILES CO.: Narrows, 28 Aug. 1933, *Alexander, Everett & Pearson* (NY); Eggleston, *Biltmore Herb. 317g* (US), 4 June, 1890, *Brown et al.* (NY), *Fogg 13361* (UP), and *14656* (MBG); Peters Mtn., *Fogg 15038* (G, UP). GRAYSON CO.: Independence, *Gleason 8759* (NY). GREENSVILLE CO.: Belfield, *Heller 1003* (NY, PA, US). LOUDON CO.: Harper's Ferry, 18 July 1872, *Tenbrook* (PA). PAGE CO.: Powells, *Allard 3199* (G); Kimball, 15 July 1917, *Miller* (US). PRINCE GEORGE CO.: by James River, *Fernald & Long 8712* (FM, G), *9321* (G). ROANOKE CO.: Roanoke River, 5 June 1890, *Brown et al.* (NY). ROCKBRIDGE CO.: Glasgow, 29 May 1909, *Bartram* (G, PA); Lexington, 23 Aug. 1924, *Churchill* (MBG). ROCKINGHAM CO.: Mt. Crawford, *Heller & Halbach 1003* (FM, G, MBG, UM). SMYTH CO.: Marion, 22 May 1892, *Britton, Britton & Vail* (PA), and 10 June 1892 (NY); White Rock Mtn., 22 June 1892, *Britton, Britton & Vail* (NY); Marion, 10 June 1892, *Small* (FM, MBG, UP, US), 29 June 1892 (FM), and 6 July 1892 (MBG, UM, US); White Mtn., 21 June 1892, *Small* (FM); falls of Holston River, 9 July 1892, *Small* (G). SOUTHAMPTON CO.: Carey Bridge, *Fernald & Long 10265, 10266* (G). STAFFORD CO.: Falmouth, 20 Aug. 1891, *Porter* (NY, PA). SURRY CO.: Claremont Wharf, *Fernald & Long 8268* (G).

NORTH CAROLINA.—ALEXANDER CO.: 10 mi. n. of Taylorsville, *Keever 346* (DU). BLADEN CO.: e. of Elizabethtown, *Heller 14044* (MBG, UM). BUNCOMBE CO.: Asheville, Aug.-Oct. 1933, *Alexander, Everett & Pearson* (NY); Biltmore, *Biltmore Herb. 317* (MBG, UM, US), *317b* (FM, G, MBG, NY, UM, UP, US); Bald Knob Mtn., *Correll 115* (DU); Asheville, June 1925, *Kraus* (MBG); Montreat, *Standley & Bollman 10380* (US). CALDWELL CO.: Blowing Rock Mtn., 16 Aug. 1891, *Small & Heller* (FM), and Rip Shin Mtn., *343* (NY). CHATHAM CO.: Bear Creek, *Correll 636* (DU). CLAY CO.: Hayesville, *Huger 36* (NY). DURHAM CO.: Duke Forest, *Blomquist 6488* (DU), and *Oosting 33137* (DU); s. w. of Durham, *Wiegand & Manning 1207* (FM, G). FORSYTHE CO.: *Denke 1145* (DU). GUILFORD CO.: *Biltmore Herb. 317e* (US); High Point, June 1868, *Canby* (NY). HALIFAX CO.: Lake Brantley, *Williamson* (FM); Weldon, 21 May 1894, *Williamson* (PA), and July 1895 (NY). HAYWOOD CO.: Mt. Pisgah, *Blomquist 3640* (DU); Pigeon River, 21 June 1934, *Oosting* (FM, PA); Crabtree Bald,

Pew 98 (FLA); Waynesville, *Standley 5439, 5679* (US). HENDERSON CO.: n. of Hendersonville, *Caughey 675* (DU); Bearwallow Mtn., *Peattie 870* (FM). IREDELL CO.: Statesville, 7 June 1879, *Gray et al.* (PA), *Hyams* (UM), *Redfield 11670* (MBG). JACKSON CO.: Balsam, July, *Williamson* (FM). LINCOLN CO.: Lincolnton, *Curtiss* (NY). MACON CO.: Highlands, *Biltmore Herb. 317* (US); Whitesides Mtn., 11 July 1888, *Dunham* (FM), and *Oosting 3634* (DU). MADISON CO.: Hot Springs, 1 June 1899, *Churchill* (MBG), and 3 June 1899 (G, MBG); Marshall, 18 June 1920, *Davis* (MBG, UM). MITCHELL CO.: Little Roan Mtn., *Harshberger 111* (UP); Roan Mtn., 14 Aug. 1892, *Merriam* (US), 19 July 1880, *Smith* (US). ORANGE CO.: Duke Forest, *Blomquist 3639* (DU, UP); Couch Mtn., *Rodgers 37* (MBG). POLK CO.: Lynn, 28 May 1899, *Churchill* (MBG); The Shoals, *Millspaugh 4103* (FM); Bearwallow Mtn., *Peattie 868* (FM); Columbus, 15 June 1897, *Townsend* (US). RICHMOND CO.: Rockingham, *Biltmore Herb. 317d* (US). ROCKINGHAM CO.: Spray, *DeChalmot* (US); Benaja, *Wherry & Pennell 14358* (MBG, PA). RUTHERFORD CO.: Chimney Rock, *Correll, Blomquist & Garren 5137* (DU). STANLEY CO.: falls of Yadkin River, 18 Aug. 1891, *Small & Heller* (FM, US), and 23 Aug. 1894, *Small* (FM, MBG, NY, PA). SURRY CO.: Pilot Mtn., 4 July 1932, *Schallert* (ND). SWAIN CO.: 10 July 1891, *Beardslee & Kofoid* (G, MBG, UM). TRANSYLVANIA CO.: Pisgah Ridge, *House 4347* (US); between Mt. Pisgah and Brevard, *Oosting 34692* (DU); Pisgah Forest, *Rydberg 9535* (NY). UNION CO.: Clifford, 11 July 1898, *Horsford* (G, US). WAKE CO.: 8 mi. n. w. of Raleigh, *Godfrey 3979* (G), and 4 mi. s. w. of Raleigh, *5004* (DU, G). WATAUGA CO.: Blowing Rock, 15 July 1889, *Carter* (UP), and 15 June 1899, *Churchill* (G, MBG); 5 mi. w. of Blowing Rock, *Small & Heller 343* (MBG, NY, PA, UM, US); Grandfather Mtn., *Small & Heller 343* (DU, FLA, FM, NY, PA, UP, US). COUNTY NOT DETERMINED: July 1841, *Gray & Carey* (G, NY).

SOUTH CAROLINA.—AIKEN CO.: Graniteville, 21 May 1899, *Eggert* (MBG). LANCASTER CO.: 2 mi. w. of Taxahaw, *Huntley 287* (DU). OCONEE CO.: Keowee, *House 2172* (US); Newry, *House 2220* (US). ORANGEBURG CO.: Ferguson, *Godfrey & Tryon 806* (DU, G, MBG, NY, UP). RICHLAND CO.: Columbia, May 1890, *Taylor* (FM), and June 1891 (UM).

GEORGIA.—BARTOW CO.: Cartersville, *Biltmore Herb. 317c* (US). CATOOSA CO.: Ringgold, 6-12 Aug. 1895, *Small* (FM). DOUGHERTY CO.: Albany, *Pollard & Maxon 522* (G, NY, US); Albany, 9-12 July 1895, *Small* (FM). GWINNETT CO.: McGuire's Mill, 9 Sept. 1894, *Small* (FM). HART CO.: Hartwell, *Wiegand & Manning 1208* (G). RICHMOND CO.: Augusta, *Cuthbert 681* (FLA, NY). SUMTER CO.: Flint River, *Harper 1059* (NY).

ALABAMA.—AUTAUGA CO.: Prattville, *Smith* (US). DE KALB CO.: Collinsville, 29 June 1897, *Eggert* (MBG). ELMORE CO.: Tallapoosa River, Aug. 1899, *Earle* (NY). FRANKLIN CO.: Russelville, 1892, *Mohr* (US).

MISSISSIPPI.—CLARKE CO.: Shubuta, 10 Oct. 1896, *Schuchert* (US).

OHIO.—HAMILTON CO.: w. of Cincinnati, 1 July 1863, *Bodley* (PA); Cincinnati, *Buchanan* (PA), 20 June, *Lea* (PA), 4 July 1881, *Lloyd* (PA), 20 July 1886 (UP), and 25 June 1890 (MBG). MUSKINGUM CO.: Zanesville, *Sargent* (PA). SCIOTO CO.: Camp Gordon, *Demaree 10714* (G, MBG). WASHINGTON CO.: Rockland, *Biltmore Herb. 317i* (US).

WEST VIRGINIA.—FAYETTE CO.: New River, 21 July 1880, *Porter* (PA). HAMPSHIRE CO.: Hanging Rock, *Frye 805* (PA). LINCOLN CO.: Miller School, 3 July 1929, *W. Va. U. Bot. Exp.* (G). MINGO CO.: Varney School, *Berkley 970* (MBG). MONONGALIA CO.: Morgantown, *Eby* (MBG); Little Falls, *Millspaugh 864* (NY). PENDLETON CO.: Hermit Island, 3 July 1937, *Burton* (UP). WAYNE CO.: Buffalo Creek, *Plymale 613* (DU, FM, G, MBG, NY, PA, UM). WOOD CO.: Kenhawa River, June 1838, *Buckley* (MBG). COUNTY NOT DETERMINED: Ganley Bridge, *Biltmore Herb. 317b* (US).

INDIANA.—CLARK CO.: *Deam 7568* (NY); 5 mi. s. w. of Borden, *Deam 18943* (UM); n. w. of Henryville, *Deam 38914* (UM). JEFFERSON CO.: Hanover, July 1876, *Young* (NY). LAWRENCE CO.: w. of Bedford, *Kriebel 659* (DU). MARION CO.: Bridgeport,

Deam 20542 (NY). MARTIN CO.: 1 mi. above Shoals, *Deam 11402* (US), and 1 mi. w. of Huron, *17210* (G, UM). MONTGOMERY CO.: Crawfordsville, June 1889, *Seaton* (FM). WELLS CO.: Wabash River, 15 July 1897, *Deam* (FM, UM), Harrison Twp., Sec. 3, *17* (MBG, US), and e. of Bluffton, *5203* (NY).

ILLINOIS.—RICHLAND CO.: "Bird Haven", 2.5 mi. n. of Olney, 6 June 1910, *Ridgway* (US).

KENTUCKY.—BOYD CO.: *Smith et al. 3597* (G, NY, US). FAYETTE CO.: Lexington, June 1835, *Peter* (PA). HARLAN CO.: Big Black Mtn., *Camp 1514* (NY). JEFFERSON CO.: Louisville, May 1889, *Mueller* (DU, UM). MC CREARY CO.: Cumberland Falls, *Leeds 2111* (PA). MERCER CO.: Burgin, *King 90* (FM). WAYNE CO.: s. w. of Monticello, *Smith & Hodgdon 3866* (G, US). WHITLEY CO.: n. e. of Jellico, *Smith & Hodgdon 3818* (FM, G, PA, US). COUNTY NOT DETERMINED: Kentucky River, May 1833, *Peter* (NY); 1840, *Short* (NY), and 1842 (PA).

TENNESSEE.—BLOUNT CO.: Kinzel Springs, 18 June 1931, *Jennison* (US); 2.5 mi. s. of Walland, 9 June 1934, *Wherry* (UP). CHEATHAM CO.: w. of Pegram, *Svenson 9605* (NY, PA). FENTRESS CO.: Wolf Creek, June 1896, *Ruth* (MBG). GRAINGER CO.: Bean's Station, 13 Aug. 1880, *Smith* (US). KNOX CO.: Knoxville, *Ruth 374* (G), *776* (MBG), *1756* (NY).

MISSOURI.—BOLLINGER CO.: 5 mi. w. of Grassy, *Steyermark 14103* (MBG). IRON CO.: Des Arc, *Smith 1086* (FM). WAYNE CO.: 1 mi. e. of Greenville, *Steyermark 11276*, and w. of Greenville, *11578* (MBG). COUNTY NOT DETERMINED: Grand River, *Meehan* (UP).

STATE NOT DETERMINED.—*LeConte* (PA); Potomac Valley, June, *McCarthy* (FM); 15 July 1863, *Wister* (PA).

1a. Clematis Viorna var. flaccida (Small) Erickson, n. comb.

C. flaccida Small ex Britt. Man. 421. 1901.

Viorna flaccida Small, Fl. Southeast. U. S. 438, 1331. 1903; Britt. & Br. Ill. Fl. ed. 2, **2**:124. 1913; Small, Man. Southeast. Fl. 528. 1933.

Clematis Viorna Gray, Man. ed. 7, 403. 1908, in part.

Leaves pinnate, with 4 pairs of leaflets; leaflets simple or rarely 2–3-lobed, ovate-lanceolate, acute and apiculate, the lowermost 7–10 cm. long, very thin, velvety-pubescent beneath; sepals lavender at base, greenish toward tip; otherwise as in the species.

DISTRIBUTION: endemic in Warren Co., Kentucky.

KENTUCKY.—WARREN CO.: Bowling Green, 27 June 1897, *Price* (FM), May 1899 (NY TYPE), 10 June 1899, 16 June 1900, 8 July 1901 (MBG).

The leaf variation in *C. Viorna* is considerable, but the large, thin, pubescent, simple leaflets of this variety are quite distinct from those of the species proper.

2. Clematis Gattingeri Small in Bull. Torr. Bot. Club **24**:209. 1897.

Viorna Gattingeri Small, Fl. Southeast. U. S. 438, 1330. 1903; Small, Man. Southeast. Fl. 527. 1933.

Stem slender, angled, densely puberulent; cauline leaves pinnate, with 3–4 pairs of leaflets, rachis and petiolules puberulent, terminating in a tendril-like filament; leaflets lanceolate or broadly lanceolate, simple, entire, acute-tipped, the lower ones 5–8 cm. long, thin and membranous, densely soft-pubescent below, sparsely pubescent above; peduncles short, axillary, 1–3-flowered; floral leaves simple, 5–15 mm. long, short-petioled; flowers purple, 10–13 mm. long, campanulate; sepals

elliptic or elliptic-lanceolate, acuminate, minutely pubescent without, narrowly margined above the middle; achene-bodies ovate-elliptic to suborbicular, 4–6 mm. broad, short appressed-pubescent; achene-tails 1.5–3.0 cm. long, plumose, light brown.

Distribution: central Tennessee.

Tennessee.—davidson co.: Nashville, June 1878, *Gattinger* (MBG, NY type), July 1897 (NY, US), June 1898 (NY), above Nashville, June 1897 (MBG); Nashville, July 1897, *Williamson* (PA). franklin co.: Cumberland Mtn., 21 July 1897, *Eggert* (MBG).

The glandular appearance of the stems, petioles and leaves of the Gattinger specimens, which Small emphasized in his description, is due, as Svenson[21] has pointed out, to dust accumulation on the hairs of these organs. This glandular appearance is not evident on the other specimens cited here, and furthermore they lack flowers. However, they agree with the Gattinger specimens in leaf and other characters.

3. Clematis Addisonii Britt. ex Vail in Mem. Torr. Bot. Club **2**:28, *footnote & pl. 3*. 1890; Robins. ex Gray, Syn. Fl. N. Am. **1**:5. 1895; Britt. & Br. Ill. Fl. **2**:69. 1897, in part; Britt. Man. 422. 1901; Gray, Man. ed. 7, 403. 1908.

C viornioides Britt. ex Britt. & Br. Ill. Fl. **2**:69. 1897; Britt. Man. 422. 1901; Gray, Man. ed. 7, 403. 1908; Britt. & Br. Ill. Fl. ed. 2, **2**:123. 1913.

Viorna Addisonii Small, Fl. Southeast. U. S. 439, 1331. 1903; Britt. & Br. Ill. Fl. ed. 2, **2**:123. 1913; Small, Man. Southeast. Fl. 528. 1933.

C. ovata Torr. & Gray, Fl. N. Am. **1**:8. 1838, probably; not Pursh, Fl. Am. Sept. **2**:736. 1814.

Erect or ascending, usually much branched and bushy; stems slender, terete or obscurely ribbed, glabrous and glaucous; lower cauline leaves and floral leaves simple, 2–13 cm. long, sessile or subsessile, broadly ovate, obtuse or round-tipped, mucronate, entire, glabrous, conspicuously glaucous below, thin and inconspicuously veined; upper cauline leaves pinnate, or in small plants all the leaves simple; leaflets 2, rarely 3, pairs, more or less oblique at the base, otherwise simulating the simple leaves in all respects, basal pair usually several times as long as the terminal pair, petiole short, rachis long and slender, terminating in a tendril-like filament; flowers solitary at the ends of branches or on axillary peduncles, 1–2 cm. long, ovoid; sepals equalling or slightly exceeding the stamens, narrowly ovate, tips acute and sharply recurved, red- or blue-purple, glabrous without, margins unexpanded, tomentose; pedicels in fruit scarcely exceeding the foliage; achene-bodies orbicular to quadrangular, about 6 mm. broad, strongly compressed, broad-rimmed, finely short-pubescent; achene-tails 2.5–3.5 cm. long, plumose, yellow or tawny.

Distribution: wooded river banks, in a restricted region of the Blue Ridge in Virginia.

Virginia.—botetourt co.: Buchanan, 22 May 1881, *Churchill* (MBG). montgomery co.: 5 mi. n. of Christiansburg, 12 Oct. 1936, *Alexander & Crehan* (NY); 3.5 mi. w. of Shawsville, *Massey 2017* (G), and s. of Fagg, *3853* (G); 3.5 mi. w. s. w. of

[21] Svenson, Jour. Tenn. Acad. Sci. **16**:130. 1941.

Shawsville, 15 July 1936, *Wherry* (UP), and s. of Fagg, 15 June 1939 (UP). ROANOKE CO.: Roanoke, 16 May 1892, *Britton & Vail* (FM, US); Roanoke, 29 May 1890, *Brown et al.* (NY TYPE), 30 May-9 June 1890 (MBG, NY, PA, US), and May 1891, *Brown* (G); s. of Roanoke, *Small & Heller 219* (FM, MBG, UP, US); above Natural Bridge Station, 30 May 1909, *Bartram* (G, NY, PA); Glasgow, 3 June 1891, *Churchill* (G, MBG).

This species is unique in having both simple and compound cauline leaves. It resembles most nearly *C. glaucophylla*, but is clearly distinguished from the latter by the peculiar appearance of its few-foliolate compound leaves.

4. Clematis glaucophylla Small in Bull. Torr. Bot. Club **24**:337. 1897; Britt. Man. 422. 1901.

Viorna glaucophylla Small, Fl. Southeast. U. S. 439, 1331. 1903; Britt. & Br. Ill. Fl. ed. 2, **2**:124. 1913; Small, Man. Southeast. Fl. 528. 1933.

C. Viorna Gray, Man., ed. 7, 403. 1908, in part.

C. Addisonii Gray, *l. c.*, in part.

Stem rather slender, ribbed, glabrous; cauline leaves with 4–5 pairs of leaflets, rachis somewhat geniculate, terminating in a slender filiform appendage or minute leaflet; leaflets, at least the basal ones, usually deeply 3-lobed or 3-foliolate, but also simple, ovate, acute- to obtuse-tipped, base cordate or subcordate, basal leaflets 3–7 cm. long, thickish, with a few prominent veins, but not reticulate, glabrous on both surfaces, glaucous below; peduncles axillary, 1–3-flowered, floral leaves simple, sometimes small, sometimes larger than the cauline leaflets, approximating the latter in shape and character, but with a short petiole; flowers ovoid, 2.0–2.5 cm. long, reddish-purple; sepals ovate-lanceolate, spreading slightly at the tip, glabrous, margins unexpanded, white-tomentose; achene-bodies suborbicular, inequilateral, 2–6 mm. broad, with a moderately wide rim; achene-tails 6 cm. long, plumose, tawny, loosely intertwined or spreading.

DISTRIBUTION: in rich woods or along streams, from Virginia south to Florida and west to Arkansas; one specimen from Oklahoma.

VIRGINIA.—GILES CO.: Peter's Mtn., *Sharp 109, 118* (NY).

NORTH CAROLINA.—BUNCOMBE CO.: The Pinnacle, *Rydberg 9435* (NY). MURRAY CO.: n. of Mt. Airy, 20 June 1909, *Rusby* (NY).

SOUTH CAROLINA.—ANDERSON CO.: 1885, *Gibbes* (NY). PICKENS CO.: Six-mile Creek, *House 3382* (NY).

GEORGIA.—CATOOSA CO.: Ringgold, 6-12 Aug. 1895, *Small* (NY). DOUGHERTY CO.: Albany, 9-12 July 1895, *Small* (NY). GWINNETT CO.: McGuire's Mill, 11 July 1893, *Small* (FM, NY TYPE), 9 Sept. 1894 (NY), and 2 July 1895 (NY, UM); Yellow River store, 20 July 1893, *Small* (G, MBG, NY, US). WALKER CO.: Chickamauga, 27 May 1913, *Churchill* (G, MBG); Chickamauga Park, May 1898, *Tidestrom* (ND). COUNTY NOT DETERMINED: *LeConte* (PA); *Turner* (PA).

FLORIDA.—GADSDEN CO.: Chattahoochee River, *Bush 365* (NY, US); Victory Bridge, 14 Mar. 1937, *Expl. Party*, and 19 Aug. 1940, *Hocking* (FLA). JACKSON CO.: n. of Marianna, 17 Mar. 1937, *Expl. Party* (FLA); Marianna, 7 Aug. 1935, *Small & West* (FLA).

ALABAMA.—MARSHALL CO.: Guntersville, *Howell 816* (US). TALLAPOOSA CO.: 23 June 1897, *Earle & Baker* (MBG, NY, UM).

KENTUCKY.—BARREN CO.: Glasgow Junction, 21 May 1898, *Price* (PA), 21 May 1899 (MBG), and 26 & 27 May 1899 (MBG, NY). EDMONSON CO.: Mammoth Cave,

May 1899, *Palmer* (G, NY, US). ESTILL CO.: Irvine, *Anderson 92* (G). KNOX CO.: Barbourville, 9 July 1888, *Lloyd* (NY). ROCKCASTLE CO.: n. of Livingston, *Smith & Hodgdon 3777* (G, NY, US). WARREN CO.: Bowling Green, June 1892, *Price* (MBG).

TENNESSEE.—CHEATHAM CO.: Craggie Hope, *Pennell 11458* (PA); Kingston Springs, *Svenson 15* (G), and Pegram, *10325* (PA). DAVIDSON CO.: 5 mi. above Nashville, June-July 1897, *Gattinger* (MBG, NY, US); Nashville, *Pennell 11412* (PA); Radnor Lake, *Svenson 64* (G). FRANKLIN CO.: Sewanee, 1897, *Cuthbert* (FLA); Cowan, July 1898, *Ruth* (MBG), *205* (US), *208* (NY), *372* (G). KNOX CO.: Knoxville, 1893, *Ruth* (MBG).

ARKANSAS.—GARLAND CO.: Hot Springs, *Scully 312* (G). SEVIER CO.: Horatio, *Brinkley 97* (FM).

OKLAHOMA.—MC CURTAIN CO.: Shawneetown, *Houghton 3872* (G, MBG, NY).

C. Addisonii is closest to this species. Its other relationships appear to be with *C. Viorna*, on the one hand, which it closely resembles in leaf characters, and with which it may be found to intergrade; and on the other hand, with *C. texensis* and *C. versicolor*. With the latter two species it shares a very similar flower structure and glaucous leaves; it differs from them in the degree of reticulation of the leaves.

5. Clematis versicolor Small ex Britt. Man. 421. 1901; Gray, Man. ed. 7, 403. 1908.

Viorna versicolor Small, Fl. Southeast. U. S. 438, 1331. 1903; Britt. & Br. Ill. Fl. ed. 2, **2**:124. 1913.

C. troutbeckiana Spingarn in Gard. Chron. III, **94**:310. 1933; and in Nat. Hort. Mag. **13**:88. 1934.

A slender vine, simple or little branched; stems ribbed, glabrous, glaucous; cauline leaves with 4 pairs of leaflets, rachis slender, geniculate, terminating in a tendril-like filament; leaflets simple or rarely 2–3-lobed, ovate, base obtuse to subcordate, tip acute to rounded, not emarginate, mucronate, the basal leaflets 3–7 cm. long, with slender petiolules, glabrous, glaucescent above, glaucous below, reticulate; peduncles axillary, 3–7-flowered, the lowest pair of floral leaves similar in shape and character to the cauline leaflets but smaller and short-petioled; flowers subglobose, 1.5–2.5 cm. long, blue-lavender, fading to green toward the tips; sepals narrowly ovate, scarcely recurved at the tips, glabrous and glaucous, margins unexpanded, white-tomentose; achene-bodies orbicular and usually somewhat inequilateral, 5–6 mm. broad, moderately rimmed, closely appressed-pubescent; achene-tails 5–6 cm. long, plumose, pale yellow, rarely tawny, loosely intertwined or spreading.

DISTRIBUTION: barrens and stony woods of the Ozarks of southern Missouri and northern Arkansas; also in western Kentucky and Tennessee, southwestern Arkansas and southeastern Oklahoma.

KENTUCKY.—LOGAN CO.: 3 mi. w. of Russellville, *Gleason 8937* (NY). TODD CO.: June, *Short* (PA).

TENNESSEE.—DAVIDSON CO.: Nashville, 1884, *Gattinger* (US); Fort Donelson, June 1863, *Greene* (ND); w. of Nashville, *Shaver & Svenson 7359* (G, ND). HENDERSON CO.: w. of Lexington, *Pennell 11491* (PA).

MISSOURI.—BARRY CO.: Eagle Rock, *Bush 32* (MBG, UM, US), and *77* (G, MBG); 4.5 mi. s. w. of Viola, *Steyermark 22533* (FM, MBG, NY). CHRISTIAN CO.: 3 mi. s. w. of Chadwick, *Steyermark 23107* (FM, MBG). MC DONALD CO.: *Bush 5* (G, NY TYPE),

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and 24 July 1892 (MBG); Noel, *Bush 5771* (MBG,PA), and 9 Aug. 1908, *Palmer* (MBG); Pineville, *Palmer 39285* (MBG, US). OREGON CO.: s. of Thayer, *Pennell 11591* (PA); 1 mi. n. of Greer, *Steyermark 7075*, 3 mi. n. w. of Greer *12132*, and n. of Greer *14352* (MBG). OZARK CO.: Pontiac, *Palmer 34782* (MBG); Hammond *Steyermark 22802* (FM, MBG), and w. of Rockbridge *26931* (FM). STONE CO.: 1 mi. n. w. of Marmaros, *Steyermark 22637* (MBG). TANEY CO.: Hollister, 20 Aug. 1939, *Moore* (FM); Branson, *Palmer 5879* (US); 4 mi. s. of Ocie, *Steyermark 5301* (FM, MBG), and Hickey Spring, *5547* (MBG).

ARKANSAS.—BENTON CO.: Irwin Mtn., *Demaree 4567*, Siloam Springs, *6603*, Bentonville, *6773*, and Sulphur Springs, *6846* (US); Decatur, 1899, *Plank* (NY). CARROLL CO.: Beaver, *Bush 14828* (MBG); Eureka Springs, 8 May 1901, *Canby* (G), and 16 July 1898, *Glatfelter* (MBG); Beaver, *Palmer 6352* (US); Eureka Springs, *Wislizenus 694* (MBG). FAULKNER CO.: e. of Garfield, *Demaree 6619* (US). IZARD CO.: Guion, *Pennell 10684* (NY, PA). SEVIER CO.: Bog Springs, *Brinkley 268* (FM). WASHINGTON CO.: Farmington, 17 May 1925, *Anderson* (MBG); Illinois River, *Engelmann 163* (MBG); Wheeler, *Palmer 27011* (MBG); Farmington, Aug. 1924, *Shreve* (NY).

OKLAHOMA.—PUSHMATAHA CO.: 6 mi. n. of Finley, *Pennell 19378* (PA).

Although this species is very closely related to *C. texensis*, it can be readily distinguished by its flower color if living material is seen. In herbarium material the distinction may be made on the basis of its somewhat more slender habit and smaller size throughout, its less compound leaves and less pointed leaflet-tips. *C. versicolor* is a less variable species than *C. texensis*. Further study, particularly field study, of these two species is desirable, especially in the region between the Ozarks and the Edwards Plateau, to determine whether there are connecting forms between the two species as here understood. The writer has seen comparatively few specimens which are not from either the Edwards Plateau or the Ozarks. Those from southeastern Oklahoma and southwestern Arkansas have rather arbitrarily been assigned to *C. versicolor*, and those from northeastern Texas (Smith Co.) to *C. texensis*. Field study may change this interpretation. The specimens from Kentucky and Tennessee, also, suggest that intergradation between *C. glaucophylla* and *C. versicolor* may exist.

6. **Clematis texensis** Buckl. in Proc. Acad. Nat. Sci. Phila. **13**:448. 1862.

C. Viorna var. *coccinea* Gray in Smiths. Contr. Knowl. **5**[6] [Pl. Wright. **2**]:7. 1853; James in Jour. Cincin. Soc. Nat. Hist. **6**:119. 1883.

C. coccinea Engelm. ex Gray in Smiths. Contr. Knowl. **5**[6] [Pl. Wright. **2**]:7. 1853, as synonym; Gray in Bot. Mag. *pl. 6594*. 1881; Gray, Syn. Fl. N. Am. **1**:6. 1895.

C. texensis var. *parviflora* Lavallée, Clem. 65. *pl. 19*. 1884.

C. texensis var. *typica* Lavallée, *l. c.*

C. Viorna δ. *coccinea* Kuntze in Verh. Bot. Ver. Brandenb. **26**:133. 1885.

C. Viorna δ. *coccinea* 2. *parviflora* Kuntze, *l. c.*

C. Viorna δ. *coccinea* 3. *segreziensis* Kuntze, *l. c.* 134.

C. coccinea var. *major* Beissner ex Beissner, Schelle & Zabel, Handb. Laubh.-Benen. 108. 1903, *nomen nudum*.

C. coccinea var. *segreziensis* Beissner, *l. c.*

C. coccinea var. *parviflora* Beissner, *l. c.*

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Viorna coccinea Small, Fl. Southeast. U. S. 438, 1331. 1903.

Stem slender, ribbed, glabrous, glaucous, especially near the nodes; cauline leaves with 4–5 pairs of leaflets, rachis slender, geniculate, terminated by a tendril-like filament; leaflets simple, 2–3-lobed or rarely 3-foliolate, ovate to orbicular, bases rounded to cordate, tips obtuse, rounded or occasionally emarginate, usually with a small mucro, the basal ones 3–9 cm. long, long-petiolulate, glabrous on both surfaces, glaucous below, moderately to strongly reticulated; peduncles axillary, 1–7-flowered, the lowest pair of floral leaves approximating in size and character the cauline leaflets, but with a short petiole; flowers ovoid, 2–3 cm. long, scarlet; sepals ovate-lanceolate, recurved at the tip, glabrous, glaucous, margins scarcely expanded, white-tomentose; achene-bodies orbicular, essentially symmetrical, 6–7 mm. broad, prominently rimmed, closely appressed-pubescent; achene-tails plumose, tawny, 6–7 cm. long, loosely intertwined or spreading.

Distribution: along streams and in woods, on the Edwards Plateau of Texas and extending into northeastern Texas.

Texas.—bexar co.: Classen Ranch, *Schulz 51* (US). blanco co.: Blanco, *Palmer 12170* (MBG), *Wright* (MBG, NY, US). comal co.: New Braunfels, *Lindheimer 383* (G, MBG), *624* (PA, UP), *625*, *627*, *655* (MBG), *656* (MBG, NY, PA, TEX, US), *657* (MBG, NY, PA, US), *658* (MBG, NY, PA, TEX, UP, US);[22] New Braunfels, 17-19 April 1903, *Pilsbry* (PA). edwards co.: Frio water-hole, *Hill 65*, *66*, *67* (US). gillespie co.: Sandy Creek, *Jermy 230*, and Threadgill, *627* (MBG, US). hays co.: 2 Apr. 1881, *Buckley* (MBG, PA, US). kerr co.: Kerrville, *Heller 1607*, *1608* (FM, G, MBG, UP, US), July 1889, *Munson & Hopkins* (US), and *Palmer 9941* (MBG, US); 12 mi. s. w. of Kerrville, *Parks & Cory 23459*, *23460*, *23461* (TAM); Kerrville, *Pennell 10365* (PA); 7 June 1929, *Whitehouse* (TEX). lampasas co.: Lampasas River, *Reverchon 1684* (MBG). llano co.: Enchanted Rock, 11 June 1930, *Tharp & Whitehouse* (TEX). medina co.: Upper Seco, *Reverchon 1484* (FM, MBG, NY, UP, US); Upper Hondo, *Reverchon 1684* (MBG); Medina Dam, June 1924, *Schulz* (FM). smith co.: Lindale, 23 April, *Reverchon* (MBG); e. of Swan, *Reverchon 2962* (MBG). travis co.: Austin, *Bogusch 593* (US), *Bray 120* (NY), *Buckley* (G, NY, PA, US); above Austin, May 1860, *Buckley* (PA type); Bull Creek, 20 Apr. 1901, *Ferguson* (TEX); Austin, 3 May 1930, *Tharp* (TEX), and *York 409* (MBG); Bull Creek, 11 Apr. 1914, *Young* (MBG), and Austin, *22* (TEX). uvalde co.: Montell Creek, *Parks & Cory 13942* (TAM). county not determined: April 1848, *Lindheimer* (MBG), *57* (MBG); May 1885, *Reverchon* (G); Rio Grande, 1848, *Wright* (G).

7. **Clematis reticulata** Walt. Fl. Carol. 156. 1788; James in Jour. Cincin. Soc. Nat. Hist. 6:123. 1883; Gray, Syn. Fl. N. Am. 1:6. 1895.

C. Viorna β. reticulata Kuntze in Verh. Bot. Ver. Brandenb. 26:133. 1885, in part.

C. Viorna β. reticulata 3. *flavida* Kuntze, *l. c.*, probably.

Viorna reticulata Small, Fl. Southeast. U. S. 438, 1330. 1903; Small, Man. Southeast. Fl. 527. 1933.

V. subreticulata Harbison ex Small, Man. Southeast. Fl. 527, 1504. 1933.

C. versicolor f. *pubescens* Steyermark in Rhodora 40:71. 1938.

Stem slender, 6-angled, red, sparsely pubescent at the nodes; cauline leaves long-petioled, with 4 pairs of leaflets, rachis terminating in a tendril-like filament

[22] Several of the Lindheimer numbers listed here were assigned also to specimens of *C. Pitcheri*.

or minute leaflet; leaflets entire or rarely 2–3-lobed, usually elliptical with a rounded and mucronate tip, but varying to ovate and acute-tipped, 2–6 cm. long or longer, long-petioluled, very strongly and closely reticulated on both the upper and lower surfaces; peduncles axillary, 1–3-flowered, floral leaves usually less than 4 cm. long, otherwise simulating the cauline leaflets; flowers nodding, 1.5–2.5 cm. long; sepals equalling or somewhat exceeding the stamens, densely covered with yellow canescent pubescence,[23] tips acute, recurved, margins narrowly expanded, tomentose; achene-bodies suborbicular, symmetrical, 4 mm. broad, with a prominent rim, appressed-pubescent; achene-tails 4–6 cm. long, plumose, pale yellow-brown, loosely intertwined.

DISTRIBUTION: in sandy soil in fields and thickets, South Carolina to Florida and west to Arkansas and Texas.

SOUTH CAROLINA.—AIKEN CO.: Aiken, 24 June 1901, *Cuthbert* (FLA), *Eggleston 5062* (NY); Hamburg, 20 May 1835, *Gibbes* (NY). CHARLESTON CO.: Charleston, *Backman* (PA). RICHLAND CO.: 6 mi. s. of Columbia, 18 May 1936, *Phelson* (DU). COUNTY NOT DETERMINED: June 1888, *McCarthy* (US).

GEORGIA.—COFFEE CO.: Seventeen-mile Creek, *Harper 1463* (FM, G, MBG, NY, US). MARION CO.: w. of Buena Vista, *Harper 1408* (G, MBG, NY, US). RICHMOND CO.: Augusta, *Cuthbert 560* (NY). SCREVEN CO.: 13 July 1904, *Cuthbert* (FLA). STEWART CO.: Sanford, *Eaton 1043* (FM, G). SUMTER CO.: summer 1897, *Harper* (MBG, NY); Americus, *Tracy 3502* (MBG). COUNTY NOT DETERMINED: 1840, *Boykin* (PA).

FLORIDA.—ALACHUA CO.: Gainesville, 21 June 1931 and 22 May 1932, *Arnold* (FLA), 12 Apr. 1897, *Crawford* (PA), and June 1876, *Garber* (US); June-July 1898, *Hitchcock* (FM, MBG); Gainesville, 19 May 1940, *Murrill* (DU, MBG), w. of Gainesville, 28 May 1940 (MBG); Gainesville, 24 May 1927, *Weber & West* (FLA). BREVARD CO.: 2 mi. n. of Cocoa, 25 Sept. 1936, *Rhoads* (FLA). CLAY CO.: Green Cove Springs, *Biltmore Herb. 1996a* (US); Goldhead Branch State Park, 27 May 1939, *Murrill* (FLA). COLUMBIA CO.: Lake City, June-July 1898, *Hitchcock* (FM); Lake City, *Quaintance 60* (FM, MBG), 16 May 1892, *Rolfs* (FLA), and 59 (FM); 1 mi. w. of Lake City, *Wiegand & Manning 1204* (G). DUVAL CO.: St. Nicholas, 20 Apr. 1897, *Churchill* (G, MBG); Jacksonville, May 1893, *Curtiss* (MBG, UM), *9* (FM, G, MBG, NY, PA, UM, US), *4203* (MBG, NY, US), *4813* (G, NY, PA, UM, US), *6174* (FLA), and *9876* (MBG); Jacksonville, 28 May 1934, *Didell* (NY); *Fredholm 106* (US), *5190* (G, MBG, US); St. Nicholas, *Lighthipe 195* (MBG, NY, UM, US); Jacksonville, *Pieters 36* (US); 1 mi. n. of Tisonia, *Wiegand & Manning 1202* (G); Jacksonville, Apr., *Williamson* (FM), and 11 July 1895 (PA). FRANKLIN CO.: Apalachicola, *Chapman Herb.* (MBG, NY). GADSDEN CO.: Mt. Vernon, July-Aug. 1843, *Rugel* (NY). GILCHRIST CO.: e. of Old Town, *Small, Small & DeWinkeler 11468* (G, NY). JEFFERSON CO.: June-July 1898, *Hitchcock* (MBG). LAKE CO.: Eustis, June-July 1894, *Hitchcock* (FM, MBG, NY); Lane Park, 22 June 1941, *Murrill* (FLA); Eustis, *Nash 611* (FM, G, MBG, ND, NY, PA, UM, US), *1466* (PA), and *1890* (FM, MBG, NY, UM, US). LEON CO.: Sebring, Aug. 1935, *McFarlin* (NY). LEVY CO.: Rosewood, June 1876, *Garber* (FM, PA). MADISON CO.: June-July 1898, *Hitchcock* (FM). MANATEE CO.: Sarasota, *collector unknown 7214* (NY). ORANGE CO.: Orlando, 26 Aug. 1929, *O'Neill* (FLA, US). PASCO CO.: Fivay, 4 July 1929, *O'Neill* (FLA, US), and St. Leo (FLA). POLK CO.: Carter's, *McFarlin 4843* (TEX); Peace Creek, 2 Apr. 1880, *Smith* (US). PUTNAM CO.: Johnson, *Barnhart 2135* (FM, US); Palatka Ravine Gardens, *Correll 6402* (DU); Grandin, 25 June 1936, *Knight* (FLA); Crescent City, 11 Apr. 1882, *Mohr* (US). ST. JOHNS CO.: St. Augustine, April 1890, *MacElwee* (PA); St. Augustine, 1877, *Reynolds* (FM, NY, PA).

[23] In several specimens from the northern part of the range of this species, the sepals are nearly glabrous, resembling those of *C. glaucophylla*. They intergrade, however, with those plants having canescent sepals.

TAYLOR CO.: e. of Perry, *Small, Small & DeWinkeler 11461* (NY). VOLUSIA CO.: 5 mi. s. of Daytona, *Small, Small & DeWinkeler 10560* (NY). WALTON CO.: DeFuniak Springs, *Tracy 9450* (G, MBG, NY). COUNTY NOT DETERMINED: *Buckley* (MBG, US); *Chapman Herb.* (MBG, PA, US); *Croom 129* (NY); *Macfarlane* (UP); 1 May 1894, *Price* (MBG); *Torrey Herb.* (NY).

ALABAMA.—CONECUH CO.: Evergreen, 2 June 1897, *Earle & Baker* (MBG, NY, UM). CULLMAN CO.: Garden City, *Biltmore Herb. 15011* (NY, US). DALE CO.: Ozark, *Biltmore Herb. 1996b, 1996d* (US), and Newton *1996c* (US); Pea River, *Palmer 27234* (MBG). ELMORE CO.: Tallapoosa River, Aug. 1899, *Earle* (NY). HENRY CO.: Abbeville, *Biltmore Herb. 1996e* (US); 8 mi. n. of Headland, *Wiegand & Manning 1206* (G). JEFFERSON CO.: Shade's Mtn., *Leeds 2133* (PA). MONTGOMERY CO.: Catoma Creek, 19 Aug. 1884, *Smith* (FM, G, US). PIKE CO.: Troy, 15 May 1925, *Wherry* (PA, UP). COUNTY NOT DETERMINED: Juggsville, 1882, *Denny* (US).

TENNESSEE.—DAVIDSON CO.: Nashville, June 1878, *Gattinger* (FM).

ARKANSAS.—SEVIER CO.: Bog Springs, *Brinkley 268* (FM, G).

TEXAS.—CASS CO.: Queen City, 11 May 1925, *Wherry* (UP). CHEROKEE CO.: Chronister, 12 July 1912, *White* (TEX). HARDIN CO.: 7.5 mi. w. of Silsbee, *Cory 11218* (G). HARRIS CO.: Harrisburg, 9 Aug. 1876, *Joor* (US), *Lindheimer 5* (G). HAYS CO.: San Marcos, June 1894 & July 1897, *Stanfield* (NY). HOUSTON CO.: Grapeland, 8 June 1920, *Tharp* (TEX). MONTGOMERY CO.: Conroe, *Fisher 3250* (FM). RED RIVER CO.: *Burk* (UP). SAN AUGUSTINE CO.: San Augustine, *Crockett* (US), and *Palmer 10627a* (MBG, US). TITUS CO.: Mt. Pleasant, *Cross 5750* (US). TRAVIS CO.: Austin, *Rugel* (UP).

It seems best to unite *Viorna subreticulata* with this species. It is founded largely on the larger, somewhat thinner leaflets and lack of canescent pubescence on the outside of the sepals. The species as here understood varies considerably in these and other characters in the northeastern part of its range (*e. g. Harper 1408* and *Palmer 27234*, in which the lower surfaces of the leaves are quite pubescent) and in Texas. In Florida, however, it is relatively constant.

8. **Clematis Beadlei** (Small) Erickson, n. comb.

Viorna Beadlei Small, Man. Southeast. Fl. 527, 1504. 1933.

Stem slender, 6-angled, reddish-brown, glabrous, or slightly pubescent at the nodes; cauline leaves with 3–4 pairs of leaflets, rachis slender, finely pubescent, geniculate, terminating in a tendril-like appendage; leaflets ovate, acute or acuminate, simple and entire, or the basal ones commonly 2–3-lobed, 2.5–8.0 cm. long, thin and chartaceous, moderately and distantly reticulate; peduncles axillary, 1-flowered, floral leaves 2.5 cm. long, simple and entire, short-petioled; flowers not seen; fruiting heads 5 cm. in diameter; achene-bodies ovate, inequilateral, 4.5–5.5 mm. broad, moderately rimmed, not greatly compressed, long appressed-pubescent; achene-tails 5–6 cm. long, plumose, loosely intertwined.

DISTRIBUTION: in scattered localities from northern Georgia to Texas.

GEORGIA.—HABERSHAM CO.: Currahee Mtn., 1-3 Sept. 1894, *Small* (NY TYPE). HANCOCK CO.: Mayfield, 28 Apr. 1900, *Cuthbert* (FLA).

MISSISSIPPI.—LOWNDES CO.: Tombigee River, 5 June 1888, *Mohr* (US); Columbus, *Biltmore Herb. 1996f* (UM, US).

TENNESSEE.—WHITE CO.: Sparta, *Biltmore Herb. H/2689* (US). COUNTY NOT DETERMINED: Warren, 30 July 1900, *Biltmore Herb.* (US).

ARKANSAS.—COUNTY NOT DETERMINED: Mt. Nebo, *Biltmore Herb. 317j* (UM, US).

TEXAS.—HARRIS CO.: 9 June 1926, *Tharp 4371* (TEX).

This species is apparently closely related to *C. reticulata* but is clearly outside the range of variation of the latter.

9. **Clematis Pitcheri** T. & G. Fl. N. Am. **1**:10. 1838; Gray in Bot. Mag. *pl. 6594.* 1881; Gray, Syn. Fl. N. Am. **1**:6. 1895; Gray, Man. ed. 7, 403. 1908.

C. coloradoensis Buckl. in Proc. Acad. Nat. Sci. Phila. **13**:448. 1862.

C. Pitcheri var. *leiostylis* Gray in Bot. Mag. *pl. 6594.* 1881; Gray, Syn. Fl. N. Am. **1**:6. 1895.

C. Pitcheri var. *lasiostylis* Gray in Bot. Mag. *pl. 6594.* 1881; Gray, Syn. Fl. N. Am. **1**:6. 1895.

C. Viorna var. *Pitcheri* James in Jour. Cincin. Soc. Nat. Hist. **6**:121. 1883.

C. Sargenti Lavallée, Clem. 60, *pl. 18.* 1884.

C. Viorna β. reticulata Kuntze in Verh. Bot. Ver. Brandenb. **26**:133. 1885, in part.

C. Viorna β. reticulata 2. *membranacea* Kuntze, *l. c.*, probably.

C. Viorna β. reticulata 4. *Sargenti* Kuntze, *l. c.*

C. Viorna β. reticulata 5. *obtusifoliola* Kuntze, *l. c.*, probably.

C. Simsii Kuntze, *l. c.* 134, in part; Britt. in Mem. Torr. Bot. Club **5**:158. 1894; Britt. & Br. Ill. Fl. **2**:68. 1897; Britt. Man. 421. 1901; not Sweet, Hort. Brit. ed. 1, 1. 1827.

C. Simsii a. Pitcheri Kuntze, *l. c.* 135.

C. Simsii a. Pitcheri 2. *micrantha* Kuntze, *l. c.*

C. Simsii a. Pitcheri 3. *chrysocarpa* Kuntze, *l. c.*

C. Simsii β. normalis Kuntze, *l. c.*, in part.

C. Simsii γ. lobata Kuntze, *l. c.*

C. Simsii 1. *leiostylis* Kuntze, *l. c.*

C. Simsii 2. *lasiostylis* Kuntze, *l. c.*

C. Pitcheri var. *Sargenti* Davis ex Bailey, Cycl. Am. Hort. **1**:333. 1900.

Viorna Simsii Small, Fl. Southeast. U. S. 438, 1330. 1903.

V. Pitcheri Britt. ex Britt. & Br. Ill. Fl. ed. 2, **2**:123, *fig. 1946.* 1913; Rydb. Fl. Prair. & Plains, 336. 1932; Small, Man. Southeast. Fl. 527. 1933.

C. Simsii var. *Sargentii* Rehder in Mitt. Deutsch. Dendr. Ges. **22**:255. 1913.

A vine, simple or somewhat branched; stem 6-angled or ribbed, reddish-brown, nearly glabrous or sparsely pubescent, especially at the nodes; cauline leaves with 3–5 leaflets, rachis slender, usually slightly geniculate, terminating in a slender tendril-like filament; leaflets simple, slightly or deeply 2–5-lobed, or 3-foliolate, the ultimate leaflets varying greatly in size and shape from narrowly ovate or elliptical to broadly ovate-cordate, blunt to acute-tipped, mucronate, lowest leaflets 4–10 cm. long, blades chartaceous to coriaceous, nearly glabrous or quite pubescent below, obscurely to very strongly reticulate, but not so closely as in *C. reticulata;* peduncles axillary, 1–7-flowered, floral leaves usually smaller than, but sometimes exceeding, the cauline leaflets, simulating them in shape and other characters but with a short petiole; flowers nodding, ovoid to urceolate; sepals

slightly exceeding the stamens to twice their length, ribbed, short appressed-pubescent without, dull purple to brick-red without, deeply colored or greenish within, margins unexpanded, or moderately expanded above the middle, white-tomentose, spreading or recurved at the tip; achene-bodies orbicular, suborbicular or obscurely quadrangular, more or less inequilateral, 6–8 mm. broad, with a broad, thick rim, appressed-pubescent; achene-tails about 3 cm. long, but usually broken and hence much shorter, slender and tapering, sparsely appressed-pubescent or nearly glabrous to silky or villous, but not plumose.

Distribution: from Indiana to eastern Nebraska and south to Texas.

Indiana.—daviess co.: Glendale, 6 June 1889, *Evermann* (US). gibson co.: 5 m. n.w. of Patoka, *Deam 16919* (G, UM). knox co.: 16 mi. w. of Decker, *Deam 17044* (G, US). posey co.: 5 mi. w. of Mt. Vernon, *Deam 16801* (UM). vigo co.: Terre Haute, July 1884, *Mohr & Mohr* (US). warren co.: 3 Aug. 1876, *Shipman* (G, PA).

Kentucky.—lyon co.: Kuttawa, *Eggleston 4551* (NY). mc cracken co.: Paducah, *Palmer 17886* (MBG, US). union co.: Rockford Bridge, *Shacklette 398* (G).

Tennessee.—davidson co.: Edgefield Junction, 8 June 1883, *Gattinger* (NY); Nashville, 1887, *Gattinger* (NY, UP), and *Hubbard* 5 (NY).

Illinois.—adams co.: Bluff Hall, *Evers 188* (MBG). carroll co.: Savannah, *Chase 1874* (UM, US). cass co.: Beardstown, *Geyer* (MBG). champaign co.: Stanton, 7 June 1919, *Pease* (G, UP); Urbana, 21 July 1884, *Waite* (US). fulton co.: Otter Creek, 6 June 1888, *Pepoon* (UM), and *1586* (G). gallatin co.: Shawneetown, *Palmer 15483* (MBG). hancock co.: Warsaw, 17 June 1847, *Mead* (G). hardin co.: Rosiclair, *Palmer 15454* (MBG). henderson co.: Oquawka, June and Aug. 1875, *Patterson* (MBG, NY). kankakee co.: Kankakee, *Crampton 225* (US), and *Greenman 3546* (G, MBG); 7 mi. n. w. of Kankakee, *Sherff 1631* (MBG). la salle co.: Peru, Sept. 1840, *Engelmann* (MBG), and 5 Aug. 1850, *Holton* (NY). logan co.: Sugar Creek, *collector unknown* (NY). macon co.: Cowford Bridge, *Clokey 2425* (G, MBG, NY, UM, US); Decatur, *Gleason 194* (G), and 21 July 1940, *Mills* (NY). marion co.: Salem, June 1860, *Bebb* (G, PA). menard co.: Athens, 1861, *Hall* (PA), and Aug. 1868 (MBG). morgan co.: Jacksonville, May 1870, *Milligan* (US). peoria co.: Peoria, June-July 1903, *McDonald* (NY), and July 1904 (G, UM); Peoria, *Stewart* (PA). piatt co.: Monticello, 30 July 1880, *Piatt* (DU). pike co.: East Hannibal, *Davis 906, 6400, 7330a* (MBG), *7330* (TEX). st. clair co.: Fish Lake, 19 June 1891, *Douglass*, and 4 mi. s. e. of East Carondelet, 4 Sept. 1891 (MBG); *Engelmann 743* (MBG); East St. Louis, 9 July 1895, *Glatfelter* (UM, US); Belleville, 1879, *Herzog* (NY); East St. Louis, 6 Sept. 1897, *Norton* (MBG); Fish Lake, 9 June 1886, *Trelease* (MBG). stark co.: Spoon River, 20 June 1896, *Chase* (PA). tazewell co.: Minert, 22 July 1881, *Seymour* (DU). union co.: Wolf Lake, *Gleason 9016* (NY). wabash co.: Mt. Carmel, *Schneck 1150* (G); Bon Pas bottoms, 28 June 1895, *Shearer* (UM). whiteside co.: Fulton, *Vasey 130* (G, NY). woodford co.: Wyatt's Ford, Aug. 1886, *Robinson* (G). county not determined: *Hall* (US); 1875, *Hyatt* (NY).

Iowa.—appanoose co.: Sedan, *Palmer 27893* (MBG). black hawk co.: Snag Creek prairie, *Burk 780* (MBG). decatur co.: 29 June 1904, *Anderson* (MBG); 7 Apr. 1898, *Fitzpatrick & Fitzpatrick* (US). johnson co.: Iowa City, 3 Aug. 1929, *Barker* (TEX); 28 June 1894, *Fitzpatrick* (G). keokuk co.: Butler's Landing, *Somes 3485* (US). muscatine co.: Muscatine, *Pammel & Reppert 1236* (MBG). polk co.: Iowaville, 25 June 1841, *Geyer* (MBG). poweshiek co.: Grinnell, Aug. 1875, *Jones* (NY, US). story co.: Ames, *Ball 217* (FM, G, MBG, NY, US), and Oct. 1906, *Pammel* (G). tama co.: Tama, *Wiegand et al. 946* (FM). van buren co.: Stockport, *Graves 2016* (MBG). wapello co.: 2 mi. w. of Eldon, *Hayden 9441* (MBG, NY, UM). county not determined: *Jones 147* (MBG); *Parry* (MBG); Cedar River, June 1884, *Treat* (UP).

MISSOURI.—ADAIR CO.: Kirksville, 8 July 1887, *Sheldon* (NY). ANDREW CO.: Nodaway, *Steyermark 15180* (MBG). ATCHISON CO.: Watson, *Bush 11* (MBG). AUDRAIN CO.: 4 mi. n. e. of Molino, *Steyermark 22441* (FM). BARRY CO.: Eagle Rock, *Bush 30*, and Shell Knob, *15564* (MBG). BATES CO.: 1.5 mi. n. w. of Papinsville, *Steyermark 9912* (FM, MBG), and 1.3 mi. s. w. of Papinsville, *9973* (FM). BENTON CO.: 2 mi. n. w. of Wisdom, *Steyermark 24424* (FM, MBG). BUTLER CO.: Poplar Bluff, 14 Aug. 1892, *Dewart* (MBG). CALDWELL CO.: 1.5 mi. s. of Kingston, *Steyermark 6096* (FM, MBG). CARROLL CO.: 1889, *Bush* (US). CASS CO.: 14 June 1865, and Pleasant Hill, *Broadhead* (MBG). CEDAR CO.: 6 mi. s. w. of Bear Creek, *Steyermark 27518* (FM). CHARITON CO.: 4 mi. n. e. of Keytesville, *Steyermark 26443* (FM, MBG). CHRISTIAN CO.: 3.5 mi. s. e. of Chadwick, *Steyermark 23036* (FM, MBG). CLARK CO.: 3 mi. n. of Gregory Landing, *Drouet 1717* (G); Alexandria, July 1893, *Wislizenus* (MBG). CLAY CO.: Excelsior Springs, *Duncan & Moyer 1586* (NY, UM). COLE CO.: 4 mi. n. of St. Thomas, *Steyermark 24939* (FM, MBG). CRAWFORD CO.: Leasburg, *Steyermark 1240* (MBG), and 3 mi. n. e. of Davisville, *21076* (MBG). DADE CO.: s. w. of Seybert, *Steyermark 5660* (FM). DALLAS CO.: 2 mi. s. w. of Windyville, *Steyermark 13749* (MBG); 5 mi. s. w. of Long Lane, *Steyermark 24239* (FM, MBG). DOUGLAS CO.: Roosevelt, *Steyermark 23316* (FM, MBG). FRANKLIN CO.: Gray Summit, 6 July 1940, *Anderson* (MBG); Washington, 25 June 1888, *Pammel* (MBG). GREENE CO.: Springfield, 26 May 1888, *Blankinship* (MBG); Ash Grove, *Standley 9271 & 9316* (US). GRUNDY CO.: Trenton, *Palmer 25487* (MBG). HENRY CO.: 3-4 mi. n. of Brownington, *Steyermark 7442* (FM). HICKORY CO.: 3 mi. n. e. of Elkton, *Steyermark 24490* (FM, MBG). HOWELL CO.: 2 mi. s. w. of Moody, *Steyermark 5241* (FM). JACKSON CO.: Independence, 31 July 1882, *Bush* (MBG); Sheffield, *Bush 10* (G, MBG, ND, NY), & *729* (MBG), and Grain Valley, *134* (MBG); Buckner, *Bush 6766, 12536* (MBG); w. of Levasey, 5 July 1897, *Mackenzie* (NY, UM), and Westport, *181* (MBG). JASPER CO.: Webb City, *Bush 6066* (MBG), and *Palmer 477* (MBG); Carterville, *Palmer 697*, Joplin, *698*, 4 mi. e. of Carthage, *1101*, Forest Mill, *2326*, Carthage, *23406* (MBG). JEFFERSON CO.: Pacific, 24 May 1882, *Eggert* (FM, MBG), and Victoria, 24 Aug. 1892 (MBG); May-June 1887, *Hasse* (FM, MBG, NY, UM); Victoria, 8 Aug. 1890, *Hitchcock* (MBG); Dittmer, *Kellogg 1744* (MBG); 6 mi. s. of Eureka, *Steyermark 1239* (MBG). JOHNSON CO.: Columbus, *Palmer 36694* (MBG). LACLEDE CO.: Bridge no. 5, 4 July 1937, *Moore* (FM); 5 mi. s. w. of Eldridge, *Steyermark 27197* (FM). LAFAYETTE CO.: Emma, 14 Aug. 1896, *Demetrio* (US). LINCOLN CO.: Winfield, *Davis 1413* (MBG). LINN CO.: Laclede, 11 July 1886, *Wislizenus* (MBG). MARION CO.: Mark Station, 10 July 1917, *Davis* (TEX), and *3748, 4171* (MBG). MONITEAU CO.: 3.5 mi. s. of Jamestown, *Steyermark 24833* (FM, MBG). NEWTON CO.: 15 July 1893, *Bush* (FM, MBG); Redings Mill, *Palmer 14369* (MBG). OSAGE CO.: 4 mi. e. of Freeburg, *Steyermark 5804* (FM, MBG). PHELPS CO.: Jerome, 25 June 1912, *Kellogg* (MBG, US), *273* (MBG), and Arlington, *Kellogg 1743* (MBG). POLK CO.: 2.5 mi. e. of Eudora, *Steyermark 24053* (MBG), and 1-2 mi. s. e. of Sentinel, *27245* (FM). PULASKI CO.: Dixon, 1928, *Child* (MBG); highway 28 at Gasconade River, *Drouet 3* (MBG). REYNOLDS CO.: w. of Gads Hill, *Steyermark 14205* (MBG). ST. CLAIR CO.: 3 mi. n. of Taberville, *Steyermark 7595* (FM, MBG). ST. FRANCOIS CO.: 1 mi. n. of Koester, *Erickson 508* (MBG). ST. LOUIS CO.: Allenton, 14 June 1887, *Eggert* (MBG, US), and 24 June 1887 (G, MBG, NY, UM, US); Valley Park, 21 June 1891, *Eggert* (MBG); Meramec Bend, 9 June 1892, *Glatfelter* (MBG, US); Glencoe, *Greenman 3850* (MBG); St. Albans, 1 June 1918, *Hoffman* (MBG); Allenton, 6 Aug. 1880, *Kellogg* (MBG); Allenton, June 1882, *Letterman* (US), 20 June 1887 (MBG, NY, PA, TEX, US), May 1889 (MBG), 1893 (MBG, TEX, UM, US), and 15 July 1898 (NY, PA, TEX, US); Meramec Highlands, 13 June 1909, *Ohlweiler* (MBG). ST.LOUIS CITY: 9 June 1901, *Kellogg* (MBG, PA, UM, US), June 1875, *Letterman* (MBG). SCHUYLER CO.: 2 mi. e. of Livonia, *Palmer & Steyermark 41068* (MBG). SHANNON CO.: 22 July 1891, *Bush* (MBG, NY, PA); Alley Spring State Park, *Steyermark 2098* (FM, MBG). STONE CO.: Galena, *Palmer 5794* (MBG, US); 2 mi. s. e. of Dorcas, *Steyermark 22679* (FM, MBG). SULLIVAN CO.: Paw Paw Junction, *Bush 52* (MBG); TANEY CO.: Swan, *Bush 163* (G, MBG, ND). TEXAS CO.: Plato, *Steyermark 25028* (FM, MBG). VERNON CO.: Deerfield, *Palmer & Steyermark 42144*

(FM, MBG, PA). WASHINGTON CO.: Potosi, 3 June 1892, *Dewart* (MBG). WEBSTER CO.: 3 mi. w. of Forkner's Hill, *Steyermark 23934* (FM, MBG). WRIGHT CO.: 2 mi. s. e. of Cedar Gap, *Steyermark 23694* (FM). COUNTY NOT DETERMINED: *Bush 137* (US); Meramec River, 28 July 1891, *Douglass* (MBG); 25 June 1875, *Eggert* (US); Grand River, Aug. 1871, *Meehan* (PA).

ARKANSAS.—HEMPSTEAD CO.: Columbus, *Palmer 10508* (MBG, US). PULASKI CO.: Pinnacle, *Wheeler 56* (FM). VAN BUREN CO.: Shirley, *Palmer 25181* (MBG). COUNTY NOT DETERMINED: Red River, *Pitcher* (NY TYPE, PA).

NEBRASKA.—RICHARDSON CO.: s. e. of Rulo, *Reynolds 2877* (NEB); e. of Du Bois, *Reynolds 2940* (NEB).

KANSAS.—COWLEY CO.: 8-10 mi. n. e. of Arkansas City, *Rydberg & Imler 529* (NY); June 1898, *White* (MBG). FRANKLIN CO.: Pomona, *Palmer 43969* (MBG). GEARY CO.: Whiskey Lake, *Gates 18683* (MBG). JEFFERSON CO.: 5 mi. n. w. of Lawrence, *Erickson 509* (MBG); Aug. 1870, *Hall* (FM). MIAMI CO.: Paola, June 1884, *Oyster* (NY). RILEY CO.: Manhattan, 12 Aug. 1892, *Hitchcock* (US), and 5 July 1886, *Kellerman* (MBG, UM, US); Manhattan, Aug. 1892, *Norton* (ND), and *1*, *1a* (MBG, NY, US); 21 Aug. 1894, *Payne & Morse* (ND); Manhattan, 30 June 1892, *Reed* (MBG). SHAWNEE CO.: Topeka, *Smyth 12* (NY). SUMNER CO.: Geuda, 4 July 1887, *Bassler* (US). WILSON CO.: Neodesha, *Palmer 21384* (US).

OKLAHOMA.—BRYAN CO.: *Blain 263* (US). CADDO CO.: between Fort Cobb & Fort Arbuckle, 1868, *Palmer 2* (NY, US). CLEVELAND CO.: 3 mi. s. of Norman, *Barkley 1466* (MBG, UM). COMANCHE CO.: Fort Sill, *Clemens 11585*, *11585a* (MBG); Camp Boulder, *Shirley 1429* (MBG); Cache, *Stevens E.M.-7* (G, MBG, UM, US). GARVIN CO.: Turner Falls State Park, *Palmer 42057* (MBG, NY, US). KIOWA CO.: Mountain Park, *Stevens 1220* (G, UM). LINCOLN CO.: 4 July 1895, *Blankinship* (US), and Fallis, 20 Aug. 1895 (G). MURRAY CO.: Davis, *Demaree 12900* (UM); Platt National Park, *Merrill 584* (MBG), *696* (NY), *Merrill & Hagan 403* (FM), and *508* (US); Davis, *Palmer 44017* (MBG). OSAGE CO.: Copan, *Stevens 2160* (G, UM). OTTAWA CO.: Miami, *Stevens 2327* (G, NY, UM). PAYNE CO.: 8.5 mi. e. of Stillwater, *Fox 80* (PA); 0.5 mi. s. of Stillwater Creek Bridge, *Gruver 64* (TEX); Stillwater, 23 Sept. 1899, *Miller* (UM), 20 June 1896, *Morris* (UM, US), 17 July 1897, *Myers* (US); *Olive 1* (NY); w. of Mehan, *Stratton 185*, and 4.3 mi. s. e. of Stillwater, *265* (MBG). WASHINGTON CO.: Copan, *Stevens 2093* (G, UM). COUNTY NOT DETERMINED: Arkansas River, *Bush 1* (MBG); Osage Nation, 30 Aug. 1895, *Kimmons* (G, US), and Creek Nation, 22 Aug. 1895 (G); *Waugh 159* (US).

TEXAS.—ARMSTRONG CO.: Gamble's Ranch, *Palmer 13951* (MBG, US). AUSTIN CO.: Industry, 1844, *Lindheimer* (MBG); e. of Wallis, *Pennell 10261* (NY, PA). BELL CO.: 1927, *Normand* (TEX); 6 mi. n. of Belton, *Wolff 855* (US), and s. of Little River, *2261* (ND, TAM). BEXAR CO.: San Antonio, *Clemens & Clemens 784*, *785* (FM, MBG); San Antonio, *Jermy 242* (G), and May 1923, *Richter* (TEX); Indianola, Sept. 1850, *Thurber* (G); San Antonio, 1853, *Thurber* (NY), 1900, *Wilkinson* (MBG), and *90* (MBG). BOWIE CO.: Texarkana, *Bush 2494* (AA, MBG). BRAZORIA CO.: Columbia, *Bush 876*, *1484* (MBG). BROWN CO.: Brownwood, *Palmer 29569* (MBG). BURNET CO.: Marble Falls, *Biltmore Herb. 8129e* (UM, US), *Bray 108* (NY), and 29 May 1922, *Tharp* (TEX). COMAL CO.: New Braunfels, May 1848, *Lindheimer* (MBG), *384* (G, MBG, PA), *627* (G), *654* (FM, G, MBG, NY, US), *655* (FM, G, MBG, NY, PA, TEX, US), *657* (TEX). CONCHO CO.: Concho, July 1881, *Havard* (US). DALLAS CO.: Dallas, *Biltmore Herb. 8129a*, *8129b* (US); West Dallas, 23 June 1899, *Eggert* (MBG); Dallas, 16 June 1898, *Glatfelter* (MBG), 3 July 1872, *Hall* (FM), 1 June 1925, *Hynes* (TEX), and *Letterman 76* (MBG); 25 June 1874, *Reverchon* (MBG); Dallas, June-July 1877 (NY), June-July 1879 and June 1881 (US), *2961* (MBG), and *Stephenson 148a* (US). DENTON CO.: spring 1926, *Harris* (TEX); *Ruth 1488* (US). DUVAL CO.: 16 Oct. 1935, *Tharp* (TEX). EDWARDS CO.: *Parks & Cory 7425* (TAM). GALVESTON CO.: Arcadia, *Degener 4968* (NY). GILLESPIE CO.: Enchanted Rock, *Jermy 231* (MBG). GONZALES CO.: Ottine Swamp, *Parks & Cory 5682* (TAM). GUADALUPE CO.: Seguin, *Groth 191* (FM, G, NY, US); Cibolo, 3 May 1881, *Havard* (US). HARDIN CO.: 7.5 mi. w. of Silsbee, *Parks & Cory 11218* (TAM). HARRIS CO.: Houston, *Dixon 615*

(FM), and *Fisher 5086* (US); Harrisburg, *Lindheimer 5* (G, MBG, PA); 1927, *Shurow* (TEX). HAYS CO.: San Marcos, 11 June 1897, *Trelease* (MBG); San Marcos, 17 May 1921 and 7 Oct. 1928, *Whitehouse*, and 7 Oct. 1938 (TEX). HOOD CO.: Granbury, 6 May 1900, *Eggert* (MBG), and *Palmer 6509* (MBG, US). IRION CO.: Mertzon, 9 May 1924, *Cory* (TAM). KERR CO.: Kerrville, *Bray 279* (TEX, US), *Clark 558* (MBG), *Heller 1607* (FM, G, NY, PA, UM, US), *1608* (MBG, UM), July 1889, *Munson & Hopkins* (US), and *Palmer 9938* (MBG, US); 7 June 1929, *Whitehouse* (TEX). KLEBERG CO.: summer 1940, *Sinclair* (TEX). LA SALLE CO.: Cotulla, *Palmer 11315* (MBG). LLANO CO.: Enchanted Rock, *Jermy 231* (MBG, US); Bauman's, *Parks & Cory 6220* (TAM). MC CULLOCH CO.: Brady, *Studhalter 1098* (US). MC LENNAN CO.: Waco, 1893, *Pace* (MBG). MATAGORDA CO.: Palacios, *Tharp 2383* (TEX, US). MONTGOMERY CO.: *Parks 14508* (TAM). NOLAN CO.: Blackwell, *Palmer 34584* (NY), and *Studhalter 1197* (US). NUECES CO.: Nueces, Aug. 1881, *Buckley* (NY). RANDALL CO.: 14 June, *Neeley* (TEX). REAL CO.: 16 mi. n. of Leakey, *Cory 12612* (G); Thousand Springs, *Parks & Cory 8526, 12610, 12611* (TAM). REFUGIO CO.: Tivoli, 17 Apr. 1933, *Whitehouse* (TEX). RUNNELS CO.: Ballinger, *Nealley 378* (NY). SAN SABA CO.: San Saba, *Harris 523* (US). SOMERVELL CO.: 1 mi. above Glen Rose, 10 Oct. 1891, *Ward* (US). SUTTON CO.: Sonora Station, 26 June 1925, *Cory* (TAM). TARRANT CO.: Fort Worth, *Ruth 288* (G, MBG, NY, UP, US), *384* (FM, MBG, NY, UM); Trinity River, *Ruth 767* (PA, US). TAYLOR CO.: Buffalo Gap Hills, *Cory 8688* (G); Sayles, *Parks & Cory 8687* (TAM); Abilene, *Tracy 8064* (FM, G, MBG, ND, NY, TEX, UM, US). TOM GREEN CO.: San Angelo, *Palmer 11152* (MBG); San Angelo, May 1888, *Smith* (FM); 1879, *Tweedy* (NY), and Knickerbocker Ranch, *165* (US). TRAVIS CO.: Austin, *Biltmore Herb. 8129b, c, d, g & h* (US), and *Painter 107* (TEX); n. w. of Austin, 23 Aug. 1921, *Tharp*, and Austin, 3 May 1930 (TEX); Barton Creek, spring 1911, *Young* (TEX). UVALDE CO.: Concan, *Palmer 10201* (MBG, US). VALVERDE CO.: Devil's River, *Orcutt 6003* (MBG); n. of Del Rio, 25 Apr. 1903, *Pilsbry* (PA). VICTORIA CO.: Victoria, *Howell 349* (US). WEBB CO.: Laredo, Aug. 1880, *Palmer 7* (G, US). WILLIAMSON CO.: Round Rock, *Bodin 111* (US). ZAVALA CO.: Crystal City, *Hanson 688* (MBG, NY, US). COUNTY NOT DETERMINED: *Drummond* (G); Santiago, 1889, *Nealley* (FM); on the Liano, Oct. 1847, *Lindheimer* (MBG); New Gulf, 15 July 1933, *Whitehouse* (TEX); *Wilkinson* (MBG); 1845, *Wright* (G); Guadalupe, May, *Wright* (US).

The diversity of the plants included here under *C. Pitcheri* is not paralleled by any other species of the section. Certain geographical trends in the variation can be pointed out, but it has not been possible to find any consistent basis for the setting off of varieties, except the one described below. In the northern part of the range of *C. Pitcheri,* the leaves are not as much divided, and the leaflets are larger than in the Texas specimens. The expanded margin of the sepals is poorly developed in the northern part of the range, the flowers simulating those of *C. Viorna,* while farther south the margin is rather wide, so much so, in fact, that this species has been confused in the literature with *C. crispa.* Pubescence of the lower leaf surfaces is more pronounced in many of the Texan plants than in those of the more northern states. A variety *lasiostylis* was proposed by Gray to accommodate those plants, mainly from the Edwards Plateau region, which have villous achene-tails. This character, however, does not appear to correlate with other characters, and furthermore intergrades with less pubescent and glabrous achene-tails. Segregates which might be based on other characters seem to be just as untenable.

The confusion of *C. Pitcheri* with *C. reticulata,* which has so often occurred,

does not seem justifiable. The two species are well separated on the basis of leaflet shape, degree of reticulation, and nature of the achene-tails, which are plumose in *C. reticulata* but not in *C. Pitcheri.*

9a. Clematis Pitcheri var. **filifera** (Benth.) Robins. ex Gray, Syn. Fl. N. Am. **1**:6. 1895.

C. filifera Benth. Pl. Hartw. 285. 1839; Tidestr. Fl. Ariz. & N. Mex. 34. 1941.

C. Simsii δ. filifera Kuntze in Verh. Bot. Ver. Brandenb. **26**:135. 1885.

C. filifera var. *incisa* Hemsl. Biol. Centr.-Am. Bot. **1**:2. 1888.

C. dictyota Greene in Pittonia **5**:133. 1903.

Viorna dictyota Heller in Muhlenbergia **6**:96. 1910.

V. filifera Woot. & Standl. Contr. U. S. Nat. Herb. **16**:123 1913; Woot. & Standl. Contr. U. S. Nat. Herb. **19** [Fl. N. Mex.]:257. 1915.

Leaves considerably divided; leaflets comparatively small, acute or acuminate, coriaceous, strongly reticulated, pubescent below; sepals always with expanded margins above the middle; otherwise as in the species.

Distribution: along banks of streams and in canyons, western Texas, New Mexico, and Mexico.

Texas.—brewster co.: Chisos Mtns., *Bailey 374* (US); Marathon, *Berkman 3424* (TEX); Chisos Mtns., *Cory 6992* (G), *Hinckley 840* (FM, G), and *Marsh 193* (FM); Oak Canyon, *Moore & Steyermark 3382* (G, MBG, NY, PA, UM, US); Chisos Mtns., *Muehler 8001* (FM, MBG, NY, TEX, US); Alpine, *Palmer 30510* (G), and Chisos Mtns., *34160* (MBG, NY, PA); Oak Canyon, *Parks & Cory 6991* (TAM); between Alpine and Fort Davis, *Small & Wherry 12046* (NY); Buena Vista, *Sperry T153* (US); Chisos Mtns., *Sperry 203* (US), *1571* (G); n. of Alpine, *Steiger 264, 1262,* Chisos Mtns, *1144,* and w. of Alpine, *1405* (NY); Alpine, *Studhalter 1030, 1070* (US), and April 1925, *Wherry* (UP); Chisos Mtns., 7 & 14 Aug. 1915, & 15 Aug. 1920, *Young* (TEX). culberson co.: McKittrick Canyon, *Moore & Steyermark 3590* (G, MBG, NY, PA, UM); Guadalupe Mtns., 5 July 1931, *Whitehouse* (TEX), 28 Aug. 1916, *Young* (MBG, TEX), and 2 Sept. 1916 (TEX). jeff davis co.: Limpia Canyon, *Earle & Tracy 256* (NY); Little Aguja Canyon, *Moore & Steyermark 3096* (G, MBG, NY, PA, UM); Davis Mtns., *Palmer 30679* (G, TEX), Fort Davis, *32165* (G, TEX), and Little Aguja Canyon, *34553* (NY); Limpia Canyon, *Tracy & Earle 256* (ND, TAM, TEX), *Wright 454* (G); Star Mtn., 12 May 1914, *Young* (MBG); Davis Mtns., 12 May 1914, 12 Aug. 1914, 12 May 1917, and 18 Sept. 1918, *Young* (TEX). presidio co.: Chinati Mtns., *Havard 2* (G), and Aug. 1936, *Hinckley* (TEX). county not determined: Limpia River, *Bigelow* (NY); Colorado River, May 1861, *Buckley* (NY); 1887, *Nealley* (US).

New Mexico.—chaves co.: Roswell, *Earle & Earle 243* (MBG, NY, PC, UM, US); 9 mi. above Roswell, *Peacock 12* (US). dona ana co.: below Dona Ana, *Emory* (NY). eddy co.: 45 mi. s. w. of Carlsbad, *Grassl 3* (FM, NY); Carlsbad Cavern, *Lee 107* (US); Black River, *Standley 40450* (US); Guadalupe Mtns., *Wilkens 1724, 2240* (PA). grant co.: Santa Rita del Cobra, *Bigelow* (NY). lincoln co.: El Capitan Mtns., 31 Aug. 1900, *Earle & Earle* (NY); White Mtns., 5 Aug. 1901, *Wooton* (MBG, NY, PC, US). otero co.: Guadalupe Mtns., 3 Aug. 1909, *Beede, Chapline 683, 733,* and *Standley 40651, 40762* (US). torrance co.: Cibolo Valley, 6 July 1852, *Parry* (NY). county not determined: *Fendler 2* (MBG); Upper Canadian River, Apr. 1848, *Gordon* (MBG); Limpia River, *Wright 830* (PA, US); *Wright 831* (US).

Mexico.—coahuila: Sabinas, *Nelson 6168* (US); Mt. Caracol, 1880, *Palmer 4* (G, PA), Saltillo, 1880, *5* (G, PA, US), 40 mi. s. of Saltillo, 1880, *6* (G), 6 mi. e. of Saltillo, 1880, *8* (G, PA, US), Saltillo, 1898, *123* (G, MBG, NY, US); Cañon del Indio Felipe, *Stewart 136* (G); Sierra del Carmen, *Wynd & Mueller 522* (G, MBG, NY, US).

GUANAJUATO: Guanajuato, *Dugès 342* (G). HIDALGO: Jacala, *Chase 7193* (G); Zimapan, *Coulter 642* (G, NY, PA); Tula, *Pringle 11911* (G, US); Ixmiquilpan, *Purpus 472* (MBG, US); Huejutla, *Seler 648* (G). NUEVO LEÓN: Monterrey, *Arsène 6193* (US), *Mueller & Mueller 36* (TEX); 15 mi. s. w. of Galeana, *Mueller & Mueller 473, 474* (NY, TEX); Galeana, *Taylor 100* (MBG, TEX). QUERÈTARO: *Arsène 10298* (G, MBG, US), and *10456, 10484, 10487* (US); Tequisquiapan, *Nelson 3876* (G, US). SAN LUIS POTOSI: Alvarez, 1904, *Palmer 194* (G, MBG, NY, US); 1878, *Parry & Palmer 1* (G, MBG, NY, PA); Las Canoas, *Pringle 3648* (G); Bagre, *Purpus 5233* (G, MBG, NY, US); *Schaffner 29* (G), *518* (NY, US). STATE NOT DETERMINED: Guanchucho, 1880, *Dugès* (G); *Ehrenberg* (US); Faral, *Schumann 254* (G, US).

This variety is fairly well set off from *C. Pitcheri* by the greater compounding of its leaves, but it shows the same variation in pubescence of the achene-tails, and some other characters as the species.

Subsection 2. VITICELLAE

Characters of the species. Sp. 10.

10. Clematis crispa L. Sp. Pl. 543. 1753; Gray in Bot. Mag. *pl. 6594.* 1881; James in Jour. Cincin. Soc. Nat. Hist. 6:123. 1883; Gray, Syn. Fl. N. Am. 1:7. 1895; Britt & Br. Ill. Fl. 2:68. 1897; Britt. Man. 421. 1901; Gray, Man. ed. 7, 403. 1908; not Thunb. Fl. Jap. 239. 1784.

Clematitis crispa Moench, Meth. 296. 1794.

Clematis cylindrica Sims in Bot. Mag. *pl. 1160.* 1809.

C. divaricata Jacq. Eclog. Pl. 1:51, *pl. 33.* 1811.

C. Walteri Pursh, Fl. Am. Sept. 2:384. 1814.

C. cordata Sims in Bot. Mag. *pl. 1816.* 1816.

C. lineariloba DC. Syst. 1:155. 1818.

Viticella crispa Bercht. & Presl, Rostl. 1:11. 1823.

C. Simsii Sweet, Hort. Brit. ed. 1, 1. 1826; not Kuntze in Verh. Bot. Ver. Brandenb. 26:134. 1885; nor Britt. in Mem. Torr. Bot. Club 5:158. 1894; nor authors.

C. Pitcheri Carr. in Rev. Hort. 1878:10. 1878; not T. & G. Fl. N. Am. 1:10. 1838.

C. crispa var. *Walteri* Gray in Bot. Mag. *pl. 6594.* 1881; James in Jour. Cincin. Soc. Nat. Hist. 6:123. 1883; Gray, Syn. Fl. N. Am. 1:7. 1895.

C. Viticella α. *crispa* Kuntze in Verh. Bot. Ver. Brandenb. 26:136. 1885.

C. Viticella α. *crispa* 1. *pilostylis* Kuntze, *l. c.*

C. Viticella α. *crispa* 2. *leiostylis* Kuntze, *l. c.*

C. Viticella γ. *Walteri* Kuntze, *l. c.* 137.

C. Viticella γ. *Walteri* 2. *lineariloba* Kuntze, *l. c.*

Viorna cylindrica Spach, Hist. Nat. Vég. Phan. 7:269. 1839.

V. crispa Small, Fl. Southeast. U. S. 437, 1330. 1903; Britt. & Br. Ill. Fl. ed. 2, 2:123. 1913; Small, Man. Southeast. Fl. 527. 1933.

V. crispa var. *Walteri* Small, Fl. Southeast. U. S. 438, 1330. 1903.

V. obliqua Small, *l. c.* 438. 1331; Small, Man. Southeast. Fl. 527. 1933.

C. obliqua Schneider, Handb. Laubholz. 1:277. 1904.

A vine; stem slender, 6–12-angled or -ribbed, slightly pubescent at the nodes;

leaves pinnate with 2–5 pairs of leaflets, terminating in a small leaflet or in a tendril-like filament, rarely simple or 3-foliolate; leaflets usually simple and entire, but also 2–3-lobed or 3-foliolate; leaflets usually lanceolate, but varying from narrowly linear to ovate-cordate, usually acuminate, thin, glabrous, with three apparent veins from the base, but not reticulate; pedicels solitary, terminal at the ends of stems or axillary branches, without simple floral leaves; flowers 2–4 cm. long, cylindric-campanulate or urceolate-campanulate; sepals lanceolate, thin, 2–3 times as long as the stamens, with a widely expanded, crisped or undulate margin above the middle, blue or blue-purple within and without, glabrous except the margin which is white-tomentose; achene-bodies suborbicular to quadrangular, usually somewhat inequilateral, 6–9 mm. broad, moderately rimmed, finely appressed-pubescent; achene-tails stout below, tapering and slender above, 2–3 cm. long; finely appressed-pubescent, divergent, sometimes coiled toward the tips.

Distribution: in swamps and similar habitats; Atlantic and Gulf Coastal Plain, and the Mississippi River Embayment.

Virginia.—henrico co.: Richmond, 1874, *Atwater* (US). nansemond co.: n. of Whitemarsh School, *Fernald & Long, 10646, 10647, 10648* (G). norfolk co.: between Northwest & Maycock, 25 May 1893, *Britton & Small* (FM, MBG, NY, PA, UP, US); North Landing, *Fernald & Griscom 2821* (G); Great Bridge, *Fernald & Long 3932* (G, UP), *3933* (G); Northwest, *Heller 847* (MBG, PA, UM, UP); Dismal Swamp, *Kearney 1503* (US), 4 June 1899, *Palmer & Bartsch* (G, MBG, US), and *Pollard 836* (FM, NY, US). princess anne co.: Edgeriver Marshes, *Kearney 1348* (US). southampton co.: Cypress Bridge, *Fernald & Long 6209* (G, UP), *8269* (G), and Knight Seine Beach, *10267* (G); Franklin, *Heller 847* (FM, G). sussex co.: s. e. of Burt, *Fernald & Long 6597* (G, NY).

North Carolina.—beaufort co.: Washington, 10 July 1934, *Blomquist* (PA), *3635, 5583* (DU), *Godfrey 3746* (G). bladen co.: Clarkton, *Biltmore Herb. 1990b* (G, NY, US); Elizabethtown, *Heller 14082* (FM, MBG). brunswick co.: Cape Fear River, June 1897, *Ashe* (MBG); Wilmington, 23 April 1923, *Churchill* (G, UM); Lake Waccamauw, 10 Apr. 1935, *Matthews* (DU). camden co.: Elizabeth City, *Correll 2081* (DU). carteret co.: Newport, *Godfrey 4448* (G); New Bern, *Hill 122* (DU). chowan co.: Edenton, *Correll 2042* (DU); Edenton, *Godfrey 5342* (G). columbus co.: Reaves Ferry, 25 June 1934, *Schallert* (ND), and Bughill, *9413* (DU); 3 mi. e. of Hallsboro, *Wiegand & Manning 1200* (G). craven co.: 2 mi. n. e. of Havelock, *Fogg 5514* (UP). currituck co.: Sligo, *Godfrey 5291* (G). duplin co.: Rock Fish Creek, *Correll 1309* (DU); e. of Chinquapin, *Leeds 2888* (PA). hertford co.: Winton, *Godfrey 5235* (DU, G). hyde co.: 5 mi. w. of Fairfield, *Godfrey & Kerr 3853* (DU). iredell co.: Statesville, *Hyams* (MBG, UM). johnston co.: Princeton, 30 Apr. 1936, *Mitchell* (DU). martin co.: Jamesville, *Correll 1879* (DU). new hanover co.: Wilmington, 3 Oct. 1908, *Bartram* (PA), *Blomquist 3637* (DU), 26 Apr. 1923, *Churchill* (G, MBG), and May 1881, *Hyams* (UM); Angola Bay, *Moldenke 10430* (NY); n. of Wilmington, 12 May 1934, *Smith* (DU); Wilmington, July 1895, *Williamson* (PA). onslow co.: Lake Catherine, *House 4529* (US); Camp Perry, *House 5100* (NY). pasquotank co.: Elizabeth City, *Kearney 2005* (US). pender co.: Burgaw, May 1879, *Hyams* (MBG), and May 1880 (US). perquimans co.: May 1932, *Glasson* (DU, UP); Parkville, *Randolph & Randolph 671* (G). pitt co.: 2 mi. w. of Grimesland, *Wiegand & Manning 1199* (G). stanley co.: falls of the Yadkin River, 23 Aug. 1894, *Small* (PA). tyrrell co.: Columbia, *Correll 1887* (DU); 3 mi. w. of Columbia, *Godfrey & Kerr 3931* (G). county not determined: Cape Fear River, June 1897, *Ashe* (MBG); Rose Bay, 10 June-6 July 1898, *Ashe* (NY); *Curtis* (MBG, NY, PA); *LeConte* (NY); 1885, *McCarthy 1* (FM, US), *7, 18* (FM).

South Carolina.—beaufort co.: Hardeeville, April 1894, *Williamson* (PA), Mar.

(NY), and Lake Brantley, Aug. (NY). BERKELY CO.: 3 mi. n. e. of Pineville, *Godfrey & Tryon 663* (G, NY). CHARLESTON CO.: Charleston, *Backman* (PA), and *Benke 3790* (FM); St. Andrews, 18 May 1855, *Hexamer & Maier* (G); 14 mi. s. of Charleston, *Moldenke 1219* (DU, MBG, NY, UP, US); St. Johns, *collector unknown* (NY). CLARENDON CO.: 10 mi. e. of Manning, *Stone 575, 576* (PA). DORCHESTER CO.: Summerville, 13 Oct. 1835, *Gibbes* (NY), 16 Apr. 1888, *Hall* (FM), 7 Apr. 1903, *Macfarlane* (UP), *Robinson 112* (G), and 17 May 1909, *Rusby* (NY); Summerville, April 1890, *Taylor* (FM, G); Summerville, June 1891, *Taylor* (UM, US). FAIRFIELD CO.: Rich Tex, 8 May 1928, *Anderson* (MBG). GEORGETOWN CO.: Georgetown, April 1857, *Gibbes* (NY); 4 mi. w. of Georgetown, *Godfrey & Tryon 120* (G); 2 mi. n. e. of Andrews, *Godfrey & Tryon 952, 975* (G). HORRY CO.: 4 mi. s. of Myrtle Beach, *Weatherby & Griscom 16530* (DU, G, NY, UP, US). LEXINGTON CO.: Batesburg, *McGregor 6* (US). ORANGEBURG CO.: 6 mi. s. e. of Bowman, *Hubricht B1994* (MBG). WILLIAMSBURG CO.: Kingstree, *Palmer 39842* (MBG, NY, UM, US). COUNTY NOT DETERMINED: *Ravenel* (G).

GEORGIA.—BLECKLEY CO.: Cary, 23 Apr. 1933, *West* (FLA). BURKE CO.: Ogeechee River Swamp, *Harper 795* (G, MBG, NY, US). CHARLTON CO.: 6 mi. e. of Folkston, *Leeds 2566* (PA). CHATHAM CO.: Savannah, 13 April 1897, *Githens* (PA, UP). DEKALB CO.: Stone Mtn., 1 June 1899, *Curtiss* (G). EARLY CO.: Blakely, 1882, *Wade* (US). FULTON CO.: South River, *Eyles 1635* (DU). RICHMOND CO.: Augusta, 2 Apr. 1904, *Cuthbert* (FLA), and *Olney & Metcalf 1* (G). TAYLOR CO.: Patsatiga Swamp, Aug. 1872, *Weisler* (G). COUNTY NOT DETERMINED: *Baldwin* (PA); *Read* (PA).

FLORIDA.—ALACHUA CO.: 5 mi. w. s. w. of Orange Heights, *Hubricht B1992* (MBG); Gainesville, July 1934, *Weber & West* (FLA). BRADFORD CO.: between Graham and Brooker, 15 May 1940, *West & Arnold* (FLA). COLUMBIA CO.: June-July 1898, *Hitchcock* (MBG). DE SOTO CO.: from Zolfo Springs to Wauchula, *Small & DeWinkeler 9029* (NY), and Fort Ogden, 9 Dec. 1923 (FLA). DUVAL CO.: St. Nicholas, 20 Apr. 1897, *Churchill* (G, MBG); *Curtiss* (PA); St. John's River, *Curtiss 8* (FM, G, MBG, NY, US), *383* (MBG); Jacksonville, 14 Apr. 1937, *Knight* (FLA); Arlington Creek, *Lighthipe 582* (NY), and St. Nicholas, *583* (NY, UM, US). FRANKLIN CO.: Apalachicola, *Biltmore Herb. 1990a* (G, MBG, NY, US), and *Chapman Herb.* (MBG, NY). GADSDEN CO.: River Junction, *O'Neill 547* (MBG, US). GILCHRIST CO.: Hart Springs, 21 June 1939, *West & Arnold* (FLA). JACKSON CO.: Chipola River, *Chapman* (NY); e. of Marianna, 15 Mar 1937, *Expl. Party* (FLA); 3.6 mi. s. s. e. of Campbellton, *Hubricht B1991* (MBG); Marianna, 10 Sept. 1931, *West* (FLA). LA FAYETTE CO.: 9 mi. w. of Cross City, *Hume & West* (FLA). LEVY CO.: Gulf Hammock, 7 Apr. 1940, *Murrill* (MBG); Otter Creek, 11 Apr. 1934, and Gulf Hammock, 6 Apr. 1935, *West* (FLA, MBG); Fannin Springs, 2 May 1937, *West & Arnold* (FLA); Ellzey, 26 Mar. 1936, *West & Evers* (FLA, MBG); Wekiva River, 15 Apr. 1942, *West & Tissot 77* (FLA). LIBERTY CO.: Aspalaga, May 1898, *Chapman* (MBG); Hosford, *Palmer 38527* (MBG). MANATEE CO.: Myakka River, *Blodgett* (NY). ORANGE CO.: Wekiwa Springs, 9 July 1929, *Williams & West* (FLA). OSCEOLA CO.: Kissimmee, *Singletary 164* (DU). PUTNAM CO.: Palatka, 1886, *Leeds* (FM). ST. JOHNS CO.: St. Augustine, 1872, *Reynolds* (NY); Pellicers Creek, 7 Sept. 1922, *Small, Small & DeWinkeler* (G); St. Augustine, 18 Mar. 1876, *Smith* (US); Bakerville, 29 Aug. 1929, *West* (FLA). TAYLOR CO.: Hampton Springs, *Correll 5724* (DU); Perry, 10 May 1926, *Small, Mosier & Matthaus* (NY); 3 mi. w. of Perry, 13 May 1941, *Wilmot & Murrill* (FLA). WAKULLA CO.: Wakulla Springs, *Correll 5670* (DU); St. Marks, Apr. 1843, *Rugel* (MBG, NY). COUNTY NOT DETERMINED: *Baldwin* (PA); *Chapman* (MBG, NY, PA, US), *158* (NY); 1875, *Curtiss* (US); 1872, *Powell* (US); 1842-1849, *Rugel* (US); *Ware* (PA).

ALABAMA.—LEE CO.: Auburn, *Earle & Baker 1583* (NY, US). MACON CO.: *Earle & Earle 12* (G, MBG, ND, NY, US). MOBILE CO.: Mobile, *Graves 1242* (MBG, US), 1878, *Mohr* (PA), and 1 May 1888, and 14 Apr. 1898 (US). MORGAN CO.: 10 mi. below Decatur, *Svenson 7418* (G); Decatur, *Woodson & Anderson 1552* (MBG). RUSSELL CO.: 8.3 mi. n. e. of Seale, *Hubricht B1990* (MBG). TUSCALOOSA CO.: Tuscaloosa, *Nevius* (G). COUNTY NOT DETERMINED: *Buckley* (G); *Lavender 16* (PA).

MISSISSIPPI.—HARRISON CO.: Biloxi, *Earle 2023* (FM, NY), *Lloyd & Tracy 13* (NY),

Tracy 4983 (MBG, NY, US). JACKSON CO.: Ocean Springs, *Pollard 1078* (G), 29 Aug. 1895, *Skehan* (MBG, US), and *Tracy 1078* (MBG, ND, NY, US). COUNTY NOT DETERMINED: May 1859, *Hilgard* (MBG).

LOUISIANA.—AVOYELLES PAR.: Marksville, *McAtee 2179* (US). CALCASIEU PAR.: Lake Charles, *Allison 208, 212* (US); 5 mi. n. of Lake Charles, *Correll & Correll 9655* (DU); Lake Charles, *Mackenzie 511* (MBG). CATAHOULA PAR.: Sicily Island, *Peck* (PA). EAST BATON ROUGE PAR.: Baton Rouge, May 1858, *collector unknown* (NY). JEFFERSON PAR.: Gretna, *Ball 364* (G, MBG, NY, US). ORLEANS PAR.: New Orleans, *Drummond 2* (NY). OUACHITA PAR.: Monroe, 13 Apr. 1901, *Trelease* (MBG). PLAQUEMINES PAR.: 1 June 1885, *Langlois* (UP); Pointe a la Hache, 3 Apr. 1888, *Langlois* (ND), *2* (FM), and June 1880 (ND), 3 Apr. 1884, and Sept. 1884 (UM); Hermitage, Aug. 1882, *Langlois* (NY). RAPIDES PAR.: Alexandria, *Hale* (NY). ST. LANDRY PAR.: Melville, *Bush 56* (MBG, NY, UM, US). ST. MARY PAR.: Morgan City, *Correll & Correll 9340* (DU). ST. TAMMANY PAR.: Covington, *Anect 46* (US), and *Arsène 11016, 11966* (US). TANGIPAHOA PAR.: 1 mi. w. of Robert, *Correll & Correll 10542* (DU). TERREBONNE PAR.: Terrebonne, 20 Aug. 1913, *Wurzlow* (NY). PARISH NOT DETERMINED: *Carpenter* (PA).

KENTUCKY.—HICKMAN CO.: Columbus, *Palmer 15067* (MBG).

TENNESSEE.—HAYWOOD CO.: Shepherd, *Palmer 17471* (MBG, US). LAKE CO.: Reelfoot Lake, *Bain 380* (G, NY). OBION CO.: Reelfoot Lake, *Moore B30* (MBG).

ILLINOIS.—ALEXANDER CO.: Cache, *Palmer 15049* (MBG, US). PULASKI CO.: Wetaug, *Anderson & Woodson 57* (MBG). ST. CLAIR CO.: Silver Creek, June 1824, *Engelmann* (MBG).

MISSOURI.—BUTLER CO.: Neelyville, *Bush 34* (G, MBG, NY), *2540* (G, MBG, US); 19 Aug. 1892, *Eggert* (G); Poplar Bluff, 7 July 1893, *Eggert* (MBG); *Smith 638* (FM). DUNKLIN CO.: Senath, *Anderson & Woodson 32* (MBG); Campbell, 11 Sept. 1893, *Bush* (MBG), *10* (MBG, NY); Pine City, *Bush 1* (MBG); Blue Spring, 19 Aug. 1892 and 6 May 1893, *Eggert* (MBG). PEMISCOT CO.: 3 mi. s. w. of Deering, *Steyermark 5132* (FM, MBG). PULASKI CO.: 26 Apr. 1886, *Hasse* (NY). RIPLEY CO.: Naylor, *Kellogg 26193B, 26193* (ND); between Naylor and Torch, *Palmer & Steyermark 41606* (MBG); 3 mi. s. of Naylor, *Steyermark 26600, 26601* (FM).

ARKANSAS.—CHICOT CO.: Eudora, *Demaree 20948* (MBG, NY). CLAY CO.: Moark, *Bush 2578* (MBG). CRAIGHEAD CO.: Cache River, *Demaree 4298* (MBG). CRITTENDEN CO.: West Memphis, *Demaree 11360* (MBG). HEMPSTEAD CO.: Fulton, *Bush 208, 2446* (MBG); Fulton, *Canby* (PA). JACKSON CO.: Newport, *Demaree 16978* (MBG, NY, UM), and 23 Apr. 1896, *Eggert* (FM, MBG, US), 7 May 1884, *Letterman* (MBG, US), *Palmer 29756* (G), *35535* (MBG). LAWRENCE CO.: Minturn, 31 May 1939, *Anderson* (MBG); Portia, *Wheeler 25, 26* (FM). MILLER CO.: between Homan and Mandeville, 10 June 1898, *Eggert* (MBG), and 19 June 1898 (NY); Texarkana, 16 Apr. 1901, *Trelease* (MBG). POINSETT CO.: 0.5 mi. n. of Waldenburg, *Lodewyks 249* (DU, MBG, US). PULASKI CO.: Little Rock, June 1883, *Hasse* (DU); Scott, *Moore 330081* (NY). COUNTY NOT DETERMINED: Halbert, *Benke 4718* (FM).

TEXAS.—BEXAR CO.: Swearingen Ranch, *Schulz 48* (US). BOWIE CO.: Texarkana, *Palmer 22439* (MBG, US). BRAZORIA CO.: Columbia, *Bush 1284* (NY, US); 3.5 mi. e. of Angleton, *Cory 11468* (G, TAM); Ross, *Palmer 13129* (MBG); Alvin, *Tracy 9225* (G, MBG, NY, TEX, UM, UP, US). BREWSTER CO.: *Marsh 324* (FM). DALLAS CO.: Dallas, Aug. 1882, *Letterman* (US). FORT BEND CO.: Rosenberg, *Pennell 5554* (NY, UP). GALVESTON CO.: 7.8 mi. n. of High Island, *Parks & Cory 20141* (TAM). HARDIN CO.: 5 mi. s. e. of Village Mills, *Parks & Cory 22061* (TAM); 10 Sept. 1937, *Tharp* (TEX). HARRIS CO.: Cypress City, *Bell 779* (G, MBG); Genoa, *Chandler 2016* (MBG); Houston, *Fisher 5034* (US), *38110* (FM), and 6 Apr. 1872, *Hall* (FM, G, MBG, NY, US); Cedar Bayou, 2 Dec. 1918, *Hanson* (NY); Houston, *Lindheimer 4* (MBG), *Rose 4166* (US), and *Thurow 10* (US). HAYS CO.: San Marcos, June 1897, *Stanfield* (NY). JEFFERSON CO.: Beaumont, *Benke 5365* (FM, UM), 15 Mar. 1931, *Hooks & Reed* (TEX), 25 May 1901, *Long* (TEX), July 1884, *Nealley* (G), *Palmer 12729* (G, MBG), *Reverchon 2919* (MBG), *3704, 3704A* (G, MBG, US), 9 Sept. and 9 Oct. 1937, *Tharp*

(TEX). KINNEY CO.: Fort Clark, *Mearns 1428* (US). LIBERTY CO.: Dayton-Cleveland, 19 Apr. 1930, *Tharp* (TEX); Dolen, *Young 1275* (TEX). MONTGOMERY CO.: 24 mi. n. of Houston, 26 May 1907, *Thurow* (US). NEWTON CO.: 24.5 mi. n. w. of Deweyville, *Parks & Cory 22307* (TAM). ORANGE CO.: Orange, *Bray 59* (TEX, US), 11 Aug. 1880, *Letterman* (MBG, US), 4 Apr. 1931, *Wild Wood Club* (TEX). TARRANT CO.: *Ruth 288a* (G). TOM GREEN CO.: San Angelo, *Palmer 11152* (US). WEBB CO.: Laredo, 1879, *Palmer 7* (NY). COUNTY NOT DETERMINED: San Marcos, Oct., *Gregg* (MBG); Brazos, *Lindheimer 1* (MBG); *Lindheimer 4* (PA); Santiago, *Nealley 52* (G).

The great variability in leaflet outline, particularly in width, does not appear to permit the recognition of any clear-cut varietal or specific segregates, although species and varieties founded on leaf characters have been described. This is especially so since the width of leaflets appears to vary considerably on different parts of one plant. This species appears to be more closely related to *C. Viticella* L., of southern Europe and Asia Minor, than to any American species of the section. As has been indicated above, the writer is of the opinion that the European species should be included in the section VIORNA.

Subsection 3. INTEGRIFOLIAE

Erect, suffrutescent plants, simple or sometimes much branched. Leaves simple, broad, usually entire. Flowers solitary at the ends of branches, nodding, relatively small. Achene-bodies relatively small, not conspicuously rimmed. Achene-tails plumose or naked. Spp. 11-14a.

11. Clematis ochroleuca Ait. Hort. Kew. **2**:260. 1789; James in Jour. Cincin. Soc. Nat. Hist. 6:120. 1883; Gray, Syn. Fl. N. Am. **1**:7. 1895; Britt. & Br. Ill. Fl. **2**:69. 1897; Britt. Man. 422. 1901; Gray, Man. ed. 7, 403. 1908.

C. sericea Michx. Fl. Bor.-Am. **1**:319. 1803; not HBK. in DC. Syst. **1**:144. 1818.

C. uniflora Balbis, Cat. Hort. Taur. 21. 1810, *nomen nudum*.

C. ovata Pursh, Fl. Am. Sept. **2**:736. 1814; not T. & G. Fl. N. Am. **1**:8. 1838; nor Britt. ex Vail in Mem. Torr. Bot. Club **2**:29, *footnote*. 1890; nor authors.

C. ochroleuca β. T. & G. Fl. N. Am. **1**:7. 1838.

C. integrifolia α. *ochroleuca* Kuntze in Verh. Bot. Ver. Brandenb. **26**:176. 1885.

C. integrifolia α. *ochroleuca* 2. *tomentosa* Kuntze, *l. c.*

C. integrifolia α. *ochroleuca* a. *parviflora* Kuntze, *l. c.* 177.

C. integrifolia α. *ochroleuca* b. *cylindrica* Vatke ex Kuntze, *l. c.*

C. integrifolia α. *ochroleuca* c. *crispiflora* Kuntze, *l. c.*

C. integrifolia α. *ochroleuca* d. *inciso-dentata* Kuntze, *l. c.*

C. integrifolia α. *ochroleuca* e. *subverticillata* Kuntze, *l. c.*

C. integrifolia β. *ovata* Kuntze, *l. c.*, probably.

C. integrifolia β. *ovata* 2. *subglabra* Kuntze, *l. c.*, probably.

Viorna ochroleuca Small, Fl. Southeast. U. S. 439, 1331. 1903; Britt. & Br. Ill. Fl. ed. 2, **2**:125. 1913; Small, Man. Southeast. Fl. 528. 1933, in part.

Clematis ochroleuca var. *ovata* Wherry in Jour. Wash. Acad. Sci. **21**:195. 1931.

C. ochroleuca var. *sericea* Wherry, l. c. 197.

Stem erect, slender, simple or somewhat branched, 3–6 dm. high, 6-ribbed, tomentose, especially at the nodes; leaves 2–4 pairs on the primary stem, simple, subsessile, narrowly to broadly ovate, entire or rarely coarsely serrate, acute- or obtuse-tipped, those of the primary stem 6–12 cm. long, under-surface white-sericeous or tomentose when young, sometimes exceedingly so, glabrous or finely pubescent when mature; flowers solitary, terminal, nodding, narrowly urceolate, 1.5–2.5 cm. long; sepals linear-lanceolate, obtuse-tipped, narrow-margined and spreading at the tip, densely long-pubescent without; pedicels erect and elongated in fruit; achene-bodies suborbicular to fusiform, usually inequilateral, not strongly compressed, 3–4 mm. broad, narrow-rimmed, appressed-pilose above the middle; achene-tails 3–5 cm. long, plumose, light yellow or tawny, loosely intertwined or spreading.

Distribution: sandy soil in the Piedmont region, from Staten Island, New York, to northern Georgia.

New York.—kings co.: Brooklyn, May and July 1841, *Carey* (G, NY). richmond co.: Staten Island, 23 May 1864, *Allen* (FM, G, NY); New Dorp, 17 May 1884, *Britton* (FM), May and June 1887 (DU, FM, G, NY, UM, US), and various dates (FM, G, NY, PA, UP); Staten Island, May and July 1879, *Brown*, and 7 July 1895, *Cathcart* (US); Todt Hill, May 1870, *Congdon* (FM, US); New Dorp, May 1887, *Deane* (NY); Staten Island, July 1865, *Denslow* (PA), and 18 May 1915 (UP), 28 May 1864, *Eaton* (ND), 1871, *Gray* (MBG), 1867, *Hall* (MBG), 1871 (NY), *14* (MBG); New Dorp, 18 May 1889, *Hall* (FM); Natchogue, 1887, *Hollick* (NY); New Dorp, 12 May 1891, *Hulst* (UM); Grant City, 27 Aug. 1894, *Kearney* (FM, ND, NY), and 10 May 1895, *Lee* (NY); Staten Island, 1865, *Leggitt* (G); Grant City, 30 Apr. 1898, *Lewis* (NY); Staten Island, *Merriam* (PA); Todt Hill, 13 May 1894, *Pollard* (ND, US); Staten Island, *Redfield* (PA); Todt Hill, 12 May and 7 July, *Ruger* (MBG); New Dorp, 19 May 1883, *Schrenk* (ND), and 20 May 1887 (MBG); Grant City, *Svenson 6382* (ND); New Dorp, 27 May 1897, *Tyler* (MBG, UM, US); Grant City, 11 May 1895, *Van Sickle* (US).

District of Columbia.—Washington, 13 May 1878, *Chickering* (FM, MBG, NY, UM), and July, *McCarthy* (FM); 21 Apr. 1897, and 1 Aug. 1898, *Steele* (G, NY, UM); Washington, 16 July 1884, *Ward* (G).

Virginia.—arlington co.: Alexandria, June 1866, *Curtiss* (FM); Four Mile Run, *Dowell 6303* (FM, MBG), 20 June 1897, *Kearney* (NY, US), and *Painter 859* (MBG); Hunting Creek, *Painter 1251* (MBG); Naucks, *Pennell 2453* (PA, US); Arlington, May 1896, *Pollard* (NY); Four Mile Run, *Pollard 186* (ND, UM), *334* (G, NY, UM), *Ruth 51* (FM, NY), and 5 Aug., *Tidestrom* (US); Alexandria, May 1898, *Tidestrom* (ND). botetourt co.: Eagle Rock, 27 Apr. 1929, *Lewis* (PA). charlotte co.: Keysville, *Baldwin 410* (G). culpepper co.: Mitchell Station, *Allard 2676* (G). dinwiddie co.: e. of Burgess, *Fernald & Long 8271* (G), and 20 Apr. 1938, *Lewis* (G); Petersburg, *Tuomey* (PA). fairfax co.: Accotink, *Blake 9475* (G); Alexandria, 19 July 1873, *Carter* (PA); May 1866, *Curtiss* (G); 1 mi. w. of Lorton, *Randolph & Randolph 143* (G); s. of Alexandria, *Smith 3054* (G); Sept. 1931, *Wherry* (PA, UP). fauquier co.: 4 mi. w. of Turnbull, 1 mi. w. of Buckland and 3 mi. s. e. of Warrenton, 25 May 1922, *Meredith* (PA); w. of Warrenton, *Tidestrom 6231* (G). franklin co.: Bald Knob, *Wherry & Adams 2728* (UP). goochland co.: *Howell 748* (G). greenesville co.: e. of Emporia, *Fernald & Long 7840* (G); Belfield, *Heller 996* (FM, G, MBG, ND, NY, PA, UM, UP, US). henrico co.: Richmond, 25 July 1887, *Burk* (PA), May 1881, *Churchill* (MBG), and 5, 9, 13 May 1894 (G, MBG); Richmond, *DeChalmot* (US), and 20 July, *Univ. of Pa.* (UP). henry co.: Martinsville, 14 Apr. 1938, *Eaton* (G). highland co.: Headwater, 30 May 1938, *Alexander* (NY). lunenburg co.: Lunenburg, *Wherry & Pennell 14402* (PA). mecklenburg co.: 6 mi. n. of Clarksville, *Fos-*

berg 15495 (UP). PRINCE WILLIAM CO.: Antioch, *Allard 436* (G, NY). ROANOKE CO.: Roanoke, 16 May 1892, *Britton & Vail* (FM, NY, PA, US), 27 May 1892, *Brown* (G), *Burnett* (PA), 1868, *Chapman* (MBG), 1868, *Churchill* (MBG), and May 1892, *Small* (US); 5.3 mi. n. e. of Salem, 26 Apr. 1940, *Wood* (UP). SUSSEX CO.: Burt, *Fernald & Long 6208* (G, NY, UP). COUNTY NOT DETERMINED: May 1832, *Bischoff* (MBG); 1865, *Glatfelter* (MBG); Camp Humphries, *McAtee 3337* (US).

NORTH CAROLINA.—ALAMANCE CO.: Graham, *Biltmore Herb. 318b* (US). BURKE CO.: Morganton, *Canby 11669* (MBG). CALDWELL CO.: Lenoir, *Biltmore Herb. 318d* (US). DAVIE CO.: Farmington, *Biltmore Herb. 318, 318a* (US); Farmington, 9 May 1924, *Knowlton* (G). DURHAM CO.: Old Oxford Road, *Anderson 6268* (FLA, PA); Durham, *Blomquist 3638* (DU); Duke Univ. Campus, 14 May 1941, *Gift* (MBG). GRANVILLE CO.: Tar River, *Correll 474* (DU, G). GUILFORD CO.: High Point, *Biltmore Herb. 318c* (UM, US), and June 1868, *Canby* (NY); Greensboro, *Schallert 1093* (DU), *Wiegand & Manning 1201* (G). HALIFAX CO.: Weldon, 19 Apr. 1908, *Bartram* (G, PA); Roanoke Rapids, 1904, *Chase* (DU); Weldon, 11 Apr. 1925, *Murrill* (FLA), Apr. 1897, *Williamson* (NY, PA), and 19 Apr. 1908 (UP). IREDELL CO.: Statesville, *Hyams* (FM, NY), May 1881 (UM), June 1898 (US). NEW HANOVER CO.: Wilmington, *Henry 252* (UP). ORANGE CO.: Duke Forest, *Blomquist 3636* (DU). PERSON CO.: n. w. of Roxboro, 16 Sept. 1934, *Wherry* (UP). RANDOLPH CO.: June 1895, *Ashe* (NY). ROWAN CO.: Salisbury, *Curtis* (PA); Salisbury, *Heller 1* (FM, MBG, NY, PA, UM, UP); Heilig's Mill, 4-9 June 1891, *Small & Heller* (FM, G, UP, US). YADKIN CO.: Apr. 1882, *Davis* (UP). COUNTY NOT DETERMINED: *Ashe* (US); 1839, *Curtis* (US); 1841, *Curtis* (MBG); *Hyams* (US).

SOUTH CAROLINA.—ABBEVILLE CO.: Abbeville, Aug. 1898, *Parcher* (US), *1513* (UM). GEORGETOWN CO.: Georgetown, 18 May 1873, *Schott* (FM). COUNTY NOT DETERMINED: *Durand* (G).

GEORGIA.—DE KALB CO.: Stone Mtn., *Ashe* (NY). STEPHENS CO.: Toccoa, 7 Apr. 1930, *Wherry* (PA). COUNTY NOT DETERMINED: *LeConte* (NY).

There is a considerable range of variation in the degree of pubescence of the leaves in *C. ochroleuca,* but there is complete intergradation in this character; the writer has been unable to recognize any consistent geographical relation with pubescence (*e. g. Henry 252* from Wilmington, N. C. is densely sericeous, although the more pubescent forms have been supposed to be characteristic of higher altitudes.) Since it is impossible to draw a definite line, it seems best not to recognize a variety *sericea.* A similar situation with regard to pubescence is found in *C. hirsutissima.*

12. Clematis albicoma Wherry in Jour. Wash. Acad. Sci. **21**:198, *fig. 1.* 1931.

C. ochroleuca James in Jour. Cincin. Soc. Nat. Hist. **6**:120. 1883, in part; Gray, Syn. Fl. N. Am. **1**:7. 1895, in part.

C. ovata Britt. ex Vail in Mem. Torr. Bot. Club **2**:29, *footnote.* 1890; Britt. & Br. Ill. Fl. **2**:70. 1897; Britt. Man. 422. 1901; Gray, Man. ed. 7, 403. 1908; not Pursh, Fl. Am. Sept. **2**:736. 1814; nor T. & G. Fl. N. Am. **1**:8. 1838.

Viorna ovata Small, Fl. Southeast. U. S. 439, 1331. 1903; Britt. & Br. Ill. Fl. ed. 2, **2**:125. 1913.

V. albicoma Moldenke in Bull. Torr. Bot. Club **60**:57. 1933.

V. ochroleuca Small, Man. Southeast. Fl. 528. 1933, in part.

Stem erect, slender, generally much branched, 6-angled, tomentose, especially near the nodes; leaves 2–4 pairs on the primary stem, usually narrowly ovate or

elliptic, entire, acute- to obtuse-tipped, those of the primary stem 5–9 cm. long, of the branches much smaller, glabrous or sparsely pubescent below, occasionally tomentose, moderately reticulate when mature; flowers solitary, terminal, narrowly urceolate, 1.5–2.0 cm. long; sepals linear-lanceolate, blunt-tipped, pale blue-purple at the base without, faint yellow toward the tips, sericeous; pedicels in fruit erect and not greatly elongate; achene-bodies suborbicular to inversely ovate, 3–4 mm. broad, not strongly compressed, narrow-rimmed, spreading-pilose above the middle; achene-tails 3–4 cm. long, plumose, pale yellow or whitish, loosely intertwined or spreading.

Distribution: limited to shale barrens in the Alleghany Mountains of West Virginia and Virginia.

Virginia.—Alleghany co.: 1.5 mi. w. of Covington, 8 June 1929, *Wherry* (NY), 10 June 1930 (PA), and w. of Covington, 7 June 1934 (UP). Augusta co.: Deerfield, *Killip 30998* (US); 3.5 mi. n. e. of Deerfield, 16 July 1936, *Wherry* (UP). Bath co.: Hot Springs, *Hunnewell 4004* (G), *4763* (NY); Warm Springs, *Moldenke 6811* (NY); 5 mi. n. w. of Mountain Grove, 14 June 1932, *Wherry* (DU, UP), State Line Mtn., 14 June 1932 (UP), and s. w. of Hot Springs, 10 June 1930 (PA). Botetourt co.: Eagle Rock, 12 June 1933, *Wherry* (PA). Craig co.: 0.5 mi. s. e. of Newcastle, *Fogg 13255* (UP); 1 mi. w. of Craigs Creek, 12 June 1932, *Wherry* (UP). Montgomery co.: 1 mi. n. e. of Ironto, 12 June 1939, *Wherry* (UP).

West Virginia.—Greenbrier co.: White Sulphur Springs, 19 Aug. 1890 and 16 May 1897, *Britton* (NY), and *Brooks & Core 4732* (DU, PA, UM, UP); Kate's Mtn., 16 May 1892, *Brown* (NY), 22 July 1892 (G), 18 July 1940 (MBG), 16 June 1892, *Brown & Small* (NY, PA), *Core 2708* (G), 4 Sept. 1920, *Franklin* (G), 22 May 1922 (UP), and *Gilbert 511* (G); White Sulphur Springs, 13 July 1877, *Guttenberg* (US type); Kate's Mtn., *Heller 842*, (FM, G, MBG, ND, NY, PA, UM, UP, US), and *Hermann & Martin 951* (FM, G, MBG, PA, UP); White Sulphur Springs, *Mackenzie 365* (MBG); Kate's Mtn., *Martin & Erlanson 32* (DU); White Sulphur Springs, *Moldenke 6876* (NY); Kate's Mtn., 16 May 1892, *Small* (FM, G, MBG, NY, PA, UM, UP, US), July 1892 (US), 5 Sept. 1936, *Wills & Shunk* (DU). Monroe co.: Chocolate Drop, *Berkley 1288* (MBG). Pendleton co.: Brandywine, *Core 3662* (NY). County not determined: 1890, *Coville* (US).

The vicissitudes of Pursh's name, *C. ovata*, have been discussed in detail by Britton (1890) and Wherry. The writer has seen an impression of the type specimen of *C. ovata*, made by Dr. F. W. Pennell, and accepts Wherry's disposition of it. *C. albicoma* appears adequately set off from *C. ochroleuca* by its smaller leaves, more branching habit, and whitish achene-tails.

13. Clematis viticaulis Steele in Contr. U. S. Nat. Herb. **13**:364. 1911; Wherry in Jour. Wash. Acad. Sci. **21**:198. 1931.

A profusely branched shrub, 3–5 dm. high; branches slender, 6-angled, nearly glabrous; leaves numerous, simple, subsessile, lanceolate or narrowly ovate, entire, acute-tipped, 2–6 cm. long, essentially glabrous, moderately reticulate; flowers rather small, lavender; sepals glabrous or slightly pubescent without; pedicels erect in fruit, not exceeding the foliage; achene-bodies orbicular to fusiform, usually inequilateral, 3–4 mm. broad, scarcely compressed, rim not evident, finely appressed-pubescent above the middle; achene-tails 3 cm. long, plumose, reddish-brown, scarcely intertwined.

Distribution: known only from the type locality, a shale barren in Bath Co., Virginia.

VIRGINIA.—BATH CO.: Millboro, *Adams & Wherry 2412* (UP), *2413* (US), *2414* (UP, US); Millboro, 14 Oct. 1933, *Alexander, Everett & Pearson* (NY), *Killip 32484* (G), 3 Sept. 1906, *Steele* (G, NY, UM, US TYPE), and 11 June 1930, *Wherry* (G, PA, UP); w. of Millboro, 7 June 1934, *Wherry* (MBG, UP).

This species is distinguished from *C. albicoma* and *C. ochroleuca*, its nearest relatives, by its much-branched habit, small leaves, and short, reddish-brown achene-tails.

14. Clematis Fremontii S. Wats. in Proc. Am. Acad. **10**:339. 1875; Gray, Syn. Fl. N. Am. **1**:7. 1895; Britt. & Br. Ill. Fl. **2**:70. 1897; Britt. Man. 422. 1901; Gray, Man. ed. 7, 403. 1908.

C. ochroleuca var. *Fremontii* James in Jour. Cincin. Soc. Nat. Hist. **6**:120. 1883.

C. integrifolia γ. *Fremontii* Kuntze in Verh. Bot. Ver. Brandenb. **26**:177. 1885.

Viorna Fremontii Heller in Muhlenbergia **6**:96. 1910; Britt. & Br. Ill. Fl. ed. 2, **2**:125. 1913; Rydb. Fl. Prair. & Plains, 336. 1932.

Stem erect, stout, simple or somewhat branched, more or less villous-tomentose, especially at the nodes, 1.5–4.0 dm. high; leaves 3–5 pairs on the primary stem, simple, broadly ovate to nearly orbicular, sessile, obtuse-tipped, mucronate, entire or rarely very coarsely serrate, those of the primary stem 6–10 cm. long, essentially glabrous when mature, coriaceous and strongly reticulate; flowers solitary, terminal, nodding, narrowly urceolate; sepals narrowly lanceolate, about twice the length of the stamens, purple or pale blue-lavender without, fading to light green at the tips and within, glabrous to sparsely villous, with margins moderately expanded above the middle, tomentose; fruiting heads not exceeding the foliage; achene-bodies rotund to inversely ovate-rhombic, 5–6 mm. broad, densely tomentose at apex and at base of achene-tail, not greatly compressed, with a broad rim; achene-tails slender and tapering, 1–2 cm. long, but fragile and sometimes much shorter, glabrous above.

DISTRIBUTION: prairies, north-central Kansas and adjacent Nebraska.

NEBRASKA.—FRANKLIN CO.: Republican River, June 1939, *collector unknown* (NEB). NUCKOLLS CO.: Superior, 5 May 1929, *Bates* (NEB), and 10 May 1929, *Day* (NEB). WEBSTER CO.: Red Cloud, 5 June 1902 and 2 June 1909, *Bates* (NEB), and 20 May 1903, *Ducker* (NEB).

KANSAS.—CLAY CO.: Clay Center, 1933, *Masters* (KS). CLOUD CO.: *Fraser 279* (KS). ELLIS CO.: Saline River, *Albertson 12* (NEB); Ellis, 19 June 1888, *Bodin* (UM); 2 mi. w. of Hays, 18 Apr. 1937, *Bondy* (MBG, US), and *Erickson 514* (MBG); Ellis, *Gray* (FM); *Hitchcock 2* (G, KS, MBG, NY, US); 26 June 1885, *Kellerman* (KS, MBG); Hays, *Palmer 21311* (US); 2 mi. w. of Hays, *Runyon 27* (FM, UM); 3 mi. w. of Hays, *Rydberg & Imler* (KS, MBG, NY); 26 June 1885, "*Sci. Exp.*" (KS); Ellis, *Watson* (NY, PA, UP, US), Oct. 1879 (FM), 1874, 1875, June 1883 (G), and 1875 (MBG). ELLSWORTH CO.: July 1895, *Hitchcock* (KS); summer 1892, *Underwood* (NY). JEWELL CO.: 1885, *Butts* (DU); Webber, summer 1894, *Dahl* (KS); Mankato, *Osborn 1014* (KS); Lovewell, *Tolstead 411337* (MBG). LINCOLN CO.: July 1895, *Hitchcock* (KS). MITCHELL CO.: Tipton, 31 Aug. 1920, *Augustin* (NEB); 19 May 1888, *Carleton* (KS, ND); s. of Beloit, *Gates 16490* (FM, KS). OSBORNE CO.: Alton, *Heber 144* (KS); 5 mi. from Osborne City, *Shear 231* (G, MBG, NEB, NY, US). OTTAWA CO.: Delphos, 7 Aug. 1935, *Cornelius* (KS). ROOKS CO.: Rockport, 30 Apr. 1889, *Bartholomew* (NY), 19 May 1889 (NEB), and 1890 (MBG); *Bartholomew 2a* (G,

KS, MBG, ND, NY, US); Stockton, 16 July 1908, *Bates* (NEB). SALINE CO.: 3 mi. w. s. w. of Brookville, *Hancin 1735* (KS). COUNTY NOT DETERMINED: *Fremont 194* (G TYPE, NY); *Gray* (MBG).

14a. Clematis Fremontii var. Riehlii Erickson, n. var.[24]

Stem 2.5–7.0 dm. high, usually much branched or rarely simple; leaves 3–6 pairs on the primary stem, elliptic-lanceolate to elliptic-ovate, obtuse- or acute-tipped, those of the primary stem 7–14 cm. long; fruiting heads equalling or slightly surmounting the foliage; otherwise as in the species.

DISTRIBUTION: on glades (dolomite or limestone barrens) in a restricted region of the Ozarks of Missouri.

MISSOURI.—FRANKLIN CO.: Pacific, 1882, *Eggert* (MBG); Catawissa, 26 July 1887, *Eggert* (MBG, NY, US), 17 May 1891 (MBG), and 10 June 1891 (G, MBG); Gray Summit [introduced], *Greenman 4883* (MBG); 15 May 1880, *Letterman* (MBG), 24 June 1880 (FM, MBG, PA, US), May 1882 (US), June 1882 (G), and 1887 (UP);

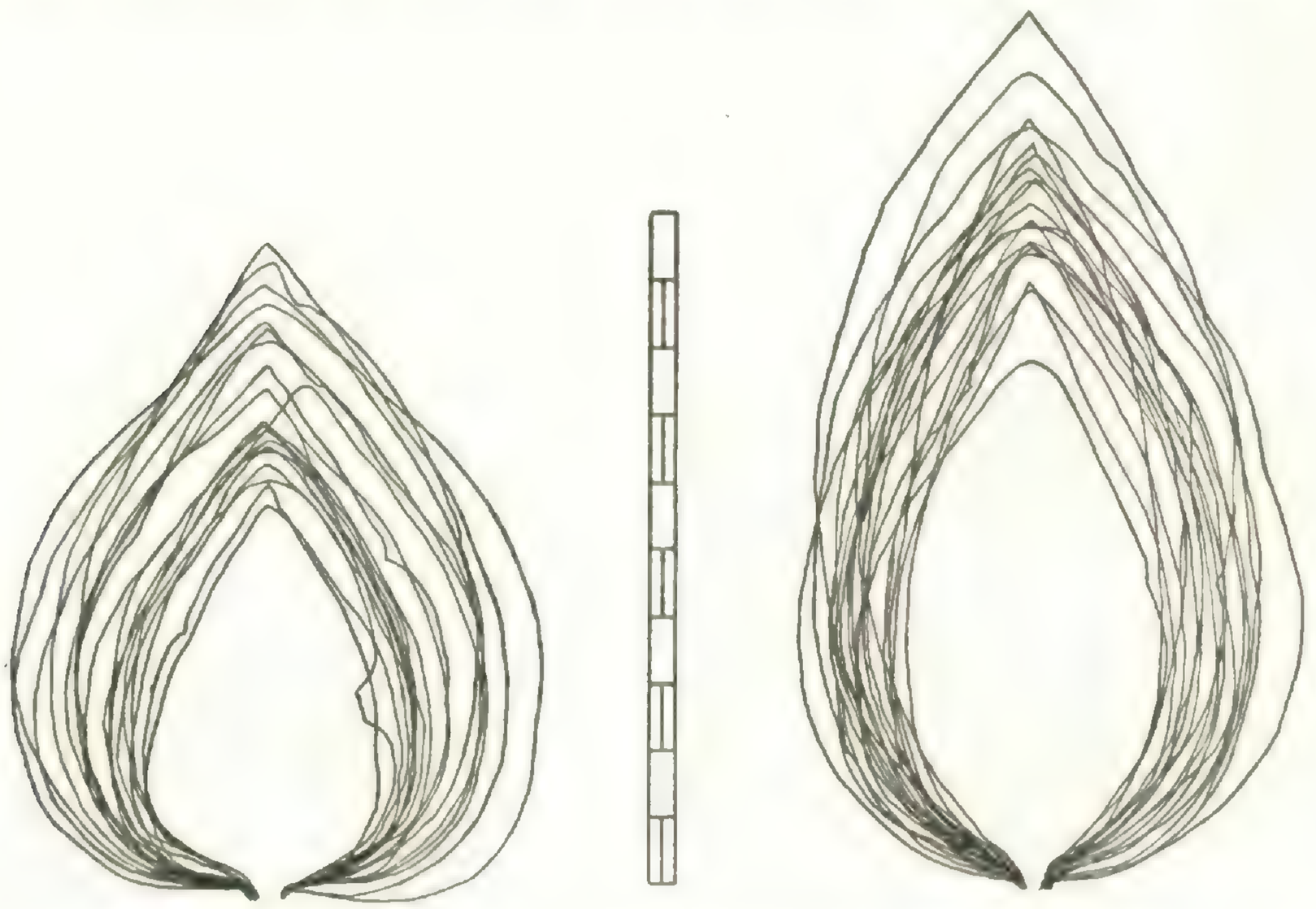

Fig. 6. Left, 20 leaf outlines from mass collection of *Clematis Fremontii* made 2 miles west of Hays, Ellis Co., Kansas *(Erickson 514)*. Right, 20 leaf outlines from mass collection of *C. Fremontii* var. *Riehlii* made 2 miles southwest of Cedar Hill, Jefferson Co., Mo. *(Erickson 548)*. Scale in centimeters.

"Morly," June 1883, *Letterman* (FM, MBG, PA, US), and 10 July 1884 (MBG, NY, US); Pacific, *Sherff 966* (FM); 1.5 mi. w. of Gray Summit [introduced], *Steyermark 1275* (MBG). JEFFERSON CO.: Hillsboro-DeSoto glade, 8 May 1937, *Chandler* (MBG); s. e. of Pacific, 16 May 1909, *Craig* (FM, MBG, NY); near Pacific, 3 Aug. 1886, 14 Apr. 1887, 11 May 1887 and 29 Apr. 1896, *Eggert* (MBG); DeSoto, 11 May 1896, *Eggert* (MBG, NY), and 27 June 1898 (MBG, NY, US); 2 mi. s. w. of Cedar Hill, *Erickson 507*, and 1.5 mi. s. of Morse Mill, *548* (MBG); DeSoto, 12 Apr. 1887, *Hasse* (FM, NY), 15 Apr. 1887 (MBG, NY), May 1887 (FM, G), and Apr. 1890 (UM); Victoria, 10 May 1890 and 8 July 1890, *Hitchcock* (MBG); Dittmer, *Kellogg 1742, 15183* (MBG);

[24] Caules 2.5–7.0 dm. alti plerumque multo ramosi vel rare simplices; foliis elliptico-lanceolatis vel elliptico-ovatis obtusis vel acutis plerumque 7–14 cm. longis; caeterumque speciei similis.

Mathias 832 (MBG); 0.5 mi. e. of Plattin, *Ownbey 719* (MBG); Hillsboro, *Riehl* (MBG TYPE); Silica, 5 May 1898, *Russell* (MBG); between Local and House Springs, *Steyermark 1112* (MBG), and between Pevely and Sand Ridge, *2034* (FM); Victoria, 1 July 1891, *Webber* (NEB); 24 May 1885, *Wislizenus* (MBG). STE. GENEVIEVE CO.: 2 mi. n. of River aux Vases, *Steyermark 20926* (MBG). WASHINGTON CO.: Washington State Park, *Hubricht B2172* (MBG); Potosi, June 1846, *Riehl* (MBG). COUNTY NOT DETERMINED OR DOUBTFUL: 17 May and 10 June 1891, *Eggert* (US); *Eggert 63* (MBG); St. Louis, May 1924, *Epling* (MBG); Allenton, 10 May and 10 June 1880, *Kellogg* (MBG); Eureka, 10 Aug. 1889, *Kellogg* (MBG); Allenton, 10 June 1880, *Letterman* (FM, MBG, UM), 20 Apr. and 10 June 1887 (FM, G, UP), 30 July 1887 (UP), and 1893 (MBG, US); 15 May 1909, *Ohlweiler* (MBG).

The difference in habit between this variety and the species proper is more striking than the measurements would indicate, and enables them to be distinguished readily. The Kansas plants present a very low, squat appearance, as compared with the more slender and open appearance of the variety *Riehlii*. The complete geographical isolation of the two entities should also be noted.

Mass collections[25] of *C. Fremontii* and *C. Fremontii* var. *Riehlii*, consisting of a single leaf from each of a number of plants, have been made at a locality in Kansas and at several in Missouri. Figure 6 shows tracings of leaf outlines from the Kansas collection and from one of the Missouri collections. The difference in leaf shape is evident and agrees with the impression one gains from a study of the herbarium material.

Subsection 4. BALDWINIANAE

Characters of the species. Sp. 15.

15. Clematis Baldwinii T. & G. Fl. N. Am. **1**:8. 1838; James in Jour. Cincin. Soc. Nat. Hist. **6**:119. 1883; Gray, Syn. Fl. N. Am. **1**:7. 1895.

Viorna Baldwinii Small, Fl. Southeast. U. S. 439, 1331. 1903; and Man. Southeast. Fl. 528. 1933.

Stems simple or with 2 branches from the uppermost node, glabrous or slightly pubescent, slender; leaves usually only 1–3 pairs on primary stem, simple and ovate-lanceolate, or deeply cleft, the divisions narrowly linear, glabrous, veins inconspicuous; flowers 1–3, borne on very long pedicels, nodding, cylindrical-campanulate; sepals linear, blue or lavender, glabrous outside except the widely expanded crisped or undulate margins which are densely white-pubescent, tips widely spreading or recurved; pedicels erect in fruit; achene-bodies suborbicular to ovate, more or less symmetrical, rimmed, long-pubescent; achene-tails 6–8 cm. long, plumose, light yellow, widely spreading.

DISTRIBUTION: sandy soil, in the flatwoods of the peninsula of Florida.

FLORIDA.—BREVARD CO.: Merritt's Island, *Moldenke 217* (MBG, NY, UP); Rockledge, 3 Mar. 1928, *Rhoads* (MBG). DADE CO.: Gossmans, *Britton 161* (FM, NY); Nov. and Dec. 1903, *Eaton* (G); Homestead, *Eaton 651* (FM); Miami, June 1877, *Garber* (G); Goulds, *Moldenke 640* (MBG, NY, UP); *Rodhem* (PA); w. of Coconut Grove, *Small 8794* (NY), and s. w. of Cutler, *865* (NY, PA); between Perrine and Camp Jackson, Nov. 1903, *Small & Carter*, n. of Perrine, 16 Jan. 1909 (PA), and n. w. of Perrine, *2995* (NY); w. of Miami, *Small, Carter & Small 3245* (NY, PA); Murden

[25] Anderson in Ann. Mo. Bot. Gard. **28**:287-292. 1941.

Hammock, *Small, Mosier & Small 6413*, Ross-Costello Hammock, *6564*, Nixon-Lewis Hammock, *6866*, and Timms Hammock, *6951* (NY); Camp Longview, *Small & Wilson 1695* (FM, NY, UM); Biscayne Key, *Tatnall 758* (PA); Silver Palm, *Young 248* (US). DUVAL CO.: Mayport and Jacksonville, 1870 and 1876, *Keeler* (NY). FLAGLER CO.: 5 mi. e. of Seville, 24 May 1940, *Murrill* (MBG). HENDRY CO.: Goodno, *Eyles 6819* (G). HERNANDO CO.: June and July 1898, *Hitchcock* (FM, MBG). HIGHLANDS CO.: Sebring, *Howell 1054* (US). HILLSBOROUGH CO.: 10 mi. n. of Tampa, *Blanton 6983* (MBG, ND, US); w. of Tampa, 30 Mar. 1923, *Churchill* (G, MBG); *Fredholm 6500* (G); Fort Dade, June, *Leavenworth* (NY, PA); Tampa Bay, Mar. 1886, *Goode* (US), and 1837, *Hulse* (NY TYPE). INDIAN RIVER CO.: Fellsmere, *Small 8895* (NY). LAKE CO.: Hawksville, 13 Mar. 1910, *Hood* (MBG); Eustis, *Nash 559* (G, NY, US). LEE CO.: Alva, *Francis 85* (US); Caloosa, 1 Apr. 1904, *Hovey* (G); Owanita, 18 Mar. 1907, *Kellogg* (G); Fort Myers, Apr. 1916, *Standley* (US), *67, 110* (FM, G, MBG, NY, US), *12607* (US), *57631, 73492* (FM); Fort Myers, 1904, *Westgate* (FM). LEVY CO.: Rosewood, June 1876, *Garber* (NY, PA, US). MANATEE CO.: 16 Mar. 1887, *Köhler & Rothrock* (FM); Manatee River, June 1845, *Rugel* (G, NY); Osprey, 15 Mar. 1904, *Smith* (PA, UM); Bradenton, 23 Mar. 1934, *Tisdale & Weber* (MBG); Sarasota, 9 Apr. 1941, *Vanderbilt* (NY); 7 Apr. 1887, *Webb* (FM, MBG, PA); Palmetto, 15 Mar. 1928, *Weber & Kelbert* (MBG); Bradenton, May 1924, *Wheeler* (FM). MARION CO.: Fort Dallas, 1859, *Cooper* (G, NY); 1.3 mi. s. of Ft. McCoy, *Hubricht B1993* (MBG). MARTIN CO.: 20 mi. w. of Stuart, 13 Apr. 1930, *Wherry* (PA, UP). OKEECHOBEE CO.: Okeechobee, Mar. 1935, *Swallen* (US). ORANGE CO.: Orlando, *Curtiss 3* (FM, G, MBG, ND, NY, PA, UM, US), Mar. 1881 (NY, PA), and *6763* (G, MBG, NY, UM, US); Lake Monroe, Mar. 1876, *Garber* (FM, NY, PA, US); Winter Park, *Huger 14* (MBG); Orlando, 1 Mar. 1927, *O'Neill* (MBG); March, *Patterson* (MBG); Orlando, *Rolfs 58* (FM, MBG); 1889, *Vesterland* (US). OSCEOLA CO.: *Fredholm 5792* (G, US). PALM BEACH CO.: w. of Jupiter, *Small et al. 9233* (G). PASCO CO.: San Antonio, *Barnhart 2704* (FM). PINELLAS CO.: Toytown, 10 Mar. 1926, *Williams* (PA), and Pasadena, 13 Apr. 1926 (MBG). POLK CO.: Fort Meade, 11 July 1922, *Armstrong & Armstrong* (MBG); Winter Haven, *McFarlin 4466* (TEX); Fort Meade, 17 Mar. 1880, *Smith* (US). PUTNAM CO.: *Biltmore Herb. 10731a* (NY). ST. JOHNS CO.: St. Augustine, Apr. 1869, *Canby* (G, PA, US), and 10 Feb. 1876, *Smith* (US). SARASOTA CO.: Sarasota, *Tracy 6746* (FM, G, MBG, NY, UM, US). SEMINOLE CO.: Sanford, 22 Oct. 1892, *Leeds* (FM), and 13 July 1895, *Williamson* (PA). VOLUSIA CO.: Seville, *Curtiss 6755* (G, MBG, NY, PA, UM, US); Haw Creek Prairie, 28 Mar. 1882, *Mohr* (US); DeLand, Mar. and Apr. 1918, *Perkins* (G); Port Orange, *Straub 76, 145* (G); s. w. of New Smyrna, 11 Mar. 1923, *Wherry* (UP); *Wright* (FM). COUNTY NOT DETERMINED: *Baldwin* (NY, PA); *Buckley* (G, MBG); Indian River, 1874, *Palmer* (FM, G, MBG); Godden's Mission, 7 and 9 Mar. 1919, *Sheehan* (NY); *Simpson 37* (NY, US); *Underwood 2348* (NY).

Subsection 5. HIRSUTISSIMAE

Erect herbs, somewhat woody in age, simple, or somewhat branched. Leaves pinnately multifid to simply pinnate, the ultimate divisions usually narrow. Flowers quite large. Sepals comparatively thin, pale without, densely soft-pubescent. Achene-bodies small, not greatly compressed, narrow-rimmed. Spp. 16–18.

16. Clematis hirsutissima Pursh, Fl. Am. Sept. **2**:385. 1814; Piper in Contr. U. S. Nat. Herb. **11** [Fl. Wash.]:266. 1906; Tidestr. in Contr. U. S. Nat. Herb. **25** [Fl. Utah & Nev.]:209. 1925.

C. Douglasii Hook. Fl. Bor.-Am. **1**:1, *pl. 1*. 1829; James in Jour. Cincin. Soc. Nat. Hist. **6**:119. 1883; Kuntze in Verh. Bot. Ver. Brandenb. **26**:180. 1885; Gray, Syn. Fl. N. Am. **1**:8. 1895; Howell, Fl. Northwest. Am. 9. 1897; Coult.

& A. Nels. New Man. Rocky Mt. Bot. 197. 1909.

C. Wyethii Nutt. in Jour. Acad. Nat. Sci. Phila. 7:6. 1834.

C. Douglasii f. *pulsatilloides* Kuntze in Verh. Bot. Ver. Brandenb. 26:180. 1885.

C. Douglasii α. *normalis* Kuntze, *l. c.*

C. Douglasii α. *normalis* 2. *erectisepala* Kuntze, *l. c.*

C. Douglasii β. *Wyethii* Kuntze, *l. c.*

C. Douglasii γ. *Jonesii* Kuntze, *l. c.*

C. Douglasii var. *rosea* Ckll. in West Am. Sci. 5:5. 1888.

Anemone patens var. *hirsutissima* Hitchc. in Trans. Acad. Sci. St. Louis 5:482. 1891.

Pulsatilla hirsutissima Britt. in Ann. N. Y. Acad. Sci. 6:217. 1891.

Anemone hirsutissima MacMillan, Metasp. Minn. Valley, 239. 1892.

Clematis Douglasii var. *Bigelovii* Jones in Proc. Cal. Acad. II, 5:614. 1895, in part.

C. Bakeri Greene in Pittonia 4:147. 1900.

C. Jonesii Rydb. in Bull. Torr. Bot. Club 29:153. 1902.

C. eriophora Rydb. *l. c.* 154; Coult. & A. Nels. New Man. Rocky Mt. Bot. 197. 1909; Tidestr. in Contr. U. S. Nat. Herb. 25 [Fl. Utah & Nev.]:209. 1925.

Viorna hirsutissima Heller in Muhlenbergia 1:40. 1904; Rydb. Fl. Rocky Mts. 291. 1917.

V. Douglasii Ckll. in Torreya 4:58. 1904.

V. Douglasii mut. *rosea* Ckll. *l. c.*

V. Bakeri Rydb. Fl. Colo. 141. 1906; Woot. & Standl. Contr. U. S. Nat. Herb. 19 [Fl. N. Mex.]:257. 1915; Rydb. Fl. Rocky Mts. 291. 1917.

V. Jonesii Rydb. Fl. Colo. 141. 1906; Rydb. Fl. Rocky Mts. 292. 1917.

V. eriophora Rydb. Fl. Colo. 141. 1906; Woot. & Standl. Contr. U. S. Nat. Herb. 19[Fl. N. Mex.]:257. 1915; Rydb. Fl. Rocky Mts. 292. 1917.

V. Wyethii Rydb. Fl. Rocky Mts. 292. 1917.

Pulsatilla patens subsp. *hirsutissima* Zámels in Acta Hort. Bot. Univ. Latv. 1:101. 1926.

Clematis Scottii var. *eriophora* Tidestr. Fl. Ariz. & N. Mex. 34. 1941.

Stems clustered, erect, 1.5–6.0 dm. high, unbranched or with 1–4 slender sterile branches; leaves 2–5 pairs, pinnate, with 7–13 bi–multifid leaflets, the ultimate divisions lanceolate to narrowly linear, 2 mm. or more in width, sometimes the lowest pair of leaves simple or nearly so, leaves densely pubescent to sparsely pilose when young, when mature nearly glabrous; flowers solitary at the ends of the stems, nodding, broadly cylindrical, base truncate, 2.5–4.0 cm. long; sepals broadly linear or slightly tapering, obtuse and slightly spreading at the tips, 1.5–2.0 times as long as the stamens, thickish but not leathery, glabrous and deep purple within, paler and densely hirsute without, margins somewhat expanded, tomentose; stamens with long filaments; pedicels erect in fruit and greatly elongate; achene-bodies broadly fusiform, inequilateral, 3–4 mm. broad, slightly

compressed laterally but without lateral depressions, rim not apparent, hirsute; achene-tails long, plumose, silvery-white to yellow or light brown, loosely intertwined or spreading.

Distribution: in the Rocky Mountains and adjacent regions, from eastern Washington to northern New Mexico.

Montana.—beaverhead co.: Lima, 14 July 1908, and Monida, 8 July 1909, *Jones* (PA); Lima, *Shear 3394, 3426* (NY). carbon co.: Red Lodge, *Rose 34* (US). cascade co.: Belt Mtns., 25 Aug. 1882, *Canby* (US); Belt River Canyon, *Williams III* (US). flathead co.: Pleasant Valley, 25-30 June 1871, *Allen* (PA, US), and 25-30 June 1871, *Hayden* (PA). gallatin co.: Fort Ellis to Yellowstone River, 15-20 July 1871, *Adams* (US); Bridger Mtns., 27 May 1899, *Blankinship* (MBG, PC); Bozeman, 5 June 1899, *Blankinship* (NY), 6 May and 4 July 1905 (MBG, PA, PC), and Mt. Bridger, 5 July 1905 (US); Bozeman, 14 May 1905, *Flaherty* (US); Middle Creek, 7 May 1926, *Franklin* (US); Bozeman, 1907, *Hodgman* (G); Bridger Mtns., 1 June 1901, *Jones* (G, MBG, US); 10 mi. s. e. of Bozeman, 4 Aug. 1887, *Knowlton* (US); Bozeman, 15 June 1899, *Moore* (G); Bridger Mtns., *Rydberg & Bessey 4096, 4100* (NY), *4097* (NY, US), and 9 June 1901, *Scheuber* (UM, US); Flathead Pass, *Scheuber 323* (NY); n. of Bozeman, 29 May 1883, *Scribner* (G, ND, PA, UP, US). lake co.: Jocko River, 15 July 1883, *Canby* (PA); Jocko Creek, *MacDougall 283* (NY, US). lewis and clark co.: Helena, 6 June 1887, *Anderson* (UM), *6* (NY), May 1888, *Harper & Harper* (FM); Helena, June 1888, *Kelsey* (UM, US), May 1891 (FM, NY), and 25 May 1892 (NY, PC, UM); Helena, *Rydberg 2651* (NY), and June 1921, *Wooton* (US). madison co.: Madison Range, *Floodman 465* (NY); M. Y. stage line, *Nelson & Nelson 5449* (G, MBG, ND, NY, PC, UM, US); Pony, *Rydberg & Bessey 4098* (NY), and Jack Creek Canyon *4101* (FM, NY). missoula co.: Missoula, *Hughes 1121* (MBG); Evaro, 13 July 1909, *Jones* (PC); Blackfoot Valley, *Kirkwood 1412* (G); Bonner, *Paulson 29* (US). park co.: Livingston, 10 May 1901, *Scheuber* (NY, US), 20 May 1901 (UM), and 25 June 1901 (US); 1901, *Scheuber 65, 89* (NY). powell co.: Clearwater Creek, 15 July 1883, *Canby* (G); Deer Lodge, June 1890, *Kelsey* (UM); MacDonald Pass, *Muenscher 11486* (MBG); Sunset, 16 June 1901, *Scheuber* (US), 14 July 1901 (UM), and *252, 253* (NY). county not determined: Black Hawk, *Floodman 466* (NY, US); 1887, *Knowlton* (US); 1889, *Tweedy* (US).

Yellowstone National Park: Mammoth Hot Springs, May and July 1893, *Burglehaus* (FM, NY, UM, US), and May 1889, *Dewart* (DU, MBG, NY); Obsidia, June 1888, *Hall* (NY); Sept. 1906, *Hapeman* (MBG); Yellowstone Lake, 1871, *Hayden* (PA); Swan Lake Valley, 7 July 1888, *Knowlton* (US); Mammoth Hot Springs, 28 May 1902, *Mearns* (FM), *839* (NY, US), *861, 1460* (US), *1020* (UM, US), and Electric Park, *196* (US); Specimen Ridge, 22 July 1902, *Smith* (FM); East Fork, *Tweedy 892* (US).

Wyoming.—albany co.: Laramie Hills, *Nelson 9564* (G, MBG, NY, UM, US). big horn co.: Big Horn Mtns., 6 Aug. 1881, *Forwood* (US), *54* (G), and 20 June 1928, *Thorp* (PA); 10-15 mi. e. of Kane, *Williams & Williams 3078* (G, MBG, NY); *Worthley 27, 99* (US). carbon co.: Hayden Forest, *Eggleston 11226* (US); e. from Encampment, *Nelson & Nelson 789* (MBG). johnson co.: Big Horn Mtns., 21 Aug. 1897, *Knight* (US), and *Tweedy 3389* (NY). laramie co.: Horse Creek, *Nelson 202* (MBG, NY, PA, PC, UM, US). lincoln co.: 5 mi. e. of Afton, *Payson & Armstrong 3365* (G, MBG, PA); La Barge, *Stevenson 103* (US); Dead Man Peak, *Williams 1298* (MBG); Shoshone Canyon, *Wiegand et al. 942* (FM); Beartooth Butte, *Williams & Williams 3666* (MBG, ND, NY). sheridan co.: Wolf, *Cary 725* (US); 19 mi. w. of Dayton, *Rollins 475* (G, MBG, ND, NY); headwaters of Tongue River, *Tweedy 171* (NY); Big Horn Mtns., *Tweedy 2406* (NY). sublette co.: Wind River Mtns., 21 July 1881, *Forwood* (US). teton co.: Teton Range, 24 July 1872, *Coulter* (PA, US); Gros Ventres Fork, 10 June 1860, *Hayden* (MBG); Teton Pass, *Williams 779* (G, MBG, ND, NY), 6 mi. w. of Jackson, *1081* (MBG), and Black Tail Butte, *1747* (MBG); 0.5 mi. e. of Moose, *Williams & Williams 2163* (G, MBG, ND). uinta co.: Carter, 25

June 1896, *Jones* (PC); Fort Bridger, Aug. 1872, *Leidy* (PA); s. of Evanston, *Pammel & Blackwood 4028* (G). WASHAKIE CO.: Middle Fork of Powder River, *Goodding 295* (G, MBG, NY, PC, US). COUNTY NOT DETERMINED: "Horn Mtns.," *Cary 35* (US); Leckie, *Merrill & Wilcox 760* (G, NY, US); 1894, *Nelson* (ND); Platte Canyon, *Nelson 8355* (RM); 1873, *Parry* (FM, G, MBG, NY, PA).

COLORADO.—ARCHULETA CO.: Pagosa, May 1883, *Brandegee* (NY); e. of Durango, 29 June 1907, *Clements* (NY); Pagosa Springs, *Smith 8* (PA). BOULDER CO.: Orodell, *Daniels 998* (MBG); Boulder, *Patterson 168* (G, MBG, NY, UM, UP, US). CLEAR CREEK CO.: Brookvale, 11, 15, and 24 June 1918, *Churchill* (G, MBG), and 21 June 1918 (MBG); Georgetown, 1885, *Patterson* (FM). CONEJOS CO.: Los Pinos, May 1899, *Baker* (MBG, NY). COSTILLA CO.: La Veta Pass, *Stone 611* (NY). DELTA CO.: Delta, *Nelson 147* (NY). EAGLE CO.: White River Forest, *Eggleston 10826* (US). EL PASO CO.: Manitou, 30 Aug. 1936, *Alexander & Crehan* (NY); Ute Pass, *Biltmore Herb. 1992b* (US), and *Brandegee 911* (MBG); Colorado Springs, *Jones 24* (NY, PA, PC, US); Ute Pass, *Letterman 106* (US), and 4-5 Aug. 1884 (MBG); Pike's Peak, *Livingston 186* (DU); Colorado Springs, *Rydberg & Vreeland 6232* (NY); Ute Pass, 29 June 1886, *Trelease* (MBG); Cascade, *Walker* (FM); Pike's Peak, *Wiegand & Upton 3242* (MBG, NY); Colorado Springs, *Williamson* (PA). GARFIELD CO.: Stuart Creek, *Graham 9725* (MBG). GRAND CO.: headwaters of Clear Creek, 1861, *Parry 82* (G, MBG, PA). GUNNISON CO.: Gate View, 5 June 1895, *Draut* (US). HUERFANO CO.: La Veta Pass, *McKelvey 4803* (UM). JEFFERSON CO.: Evergreen, *Cletus 98* (FM); Bear Creek Canyon, *Clokey 3050* (G, MBG, TEX, US); Golden City, May 1871, *Greene* (NY), and Bear Creek, 22 July 1889 (ND); Bear Creek Canyon, 25 June 1937, *Knowlton* (G); Golden City, Aug. 1871, *Meehan* (PA); 3 mi. w. of Bergen Park, 17 June 1937, *Wherry* (UP). LA PLATA CO.: between Parrott City and Hesperus, *Baker, Earle & Tracy 916* (FM, MBG, ND, NY, UM, US); Durango, *Eastwood 5367* (G, US), and *Nelson 10442* (NY); Hesperus, *Pennell 21463* (PA); Durango, 5 July 1935, *Zobel* (MBG). LARIMER CO.: Estes, *Allen 26* (MBG); 5 mi. w. of Fort Collins, 20 May 1893, *Baker* (NY, PC, UM), and w. of Fort Collins, 7 May 1896 (MBG, ND, NY); Estes Park, 29 May 1873, *Coulter* (FM, PA); 5 May 1896, *Crandall* (MBG), *8* (US), *10* (G, NY), *272* (NY), w. of Dixon Canyon, *334* (FM, NY, US), Horsetooth Gulch, *338* (G, NY, UM), and Howe's Gulch, *1379* (NY); Howes, 5 July 1895, *Earle* (FM); Camp Creek, *Goodding 1454* (G, MBG, NY, US); w. of Fort Collins, *Mathias 372* (MBG); between Loveland and Estes Park, 29 Aug. 1898, *Moyer* (UM); June 1894, *Osterhout* (UM), and 25 Apr. 1895 (MBG, UM). LAS ANIMAS CO.: between Raton Pass and Trinidad, *McKelvey 2440A* (US). MESA CO.: Fruita, *Pennell & Schaeffer 22087* (PA). MONTEZUMA CO.: West Mancos River, 26 June, *Baker, Earle & Baker* (ND); Dolores, 15 June 1892, *Crandall* (NY), and *Payson 1118* (MBG). MONTROSE CO.: Cimarron, *Baker 29* (G, MBG, NY, UM, US), *138* (G, MBG, ND, NY, US); Tabeguache Basin, *Payson 379* (FM, G, UM); Uncompahgre Plateau, *Tidestrom 1563* (US). OURAY CO.: Ridgway, *Payson & Payson 3844* (G), *Tidestrom 2138*, and *Tweedy 263* (US); w. of Ouray, *Underwood & Selby 175a* (NY). PARK CO.: July 1905, *Williamson* (PA). RIO BLANCO CO.: Flag Creek, *Tidestrom 1702* (US). ROUTT CO.: 5 mi. s. of Toponas, *Pennell & Schaeffer 22321* (PA). SAN MIGUEL CO.: Iron Springs Mesa, *Walker 527* (G, UM). COUNTY NOT DETERMINED: 1874, *Bradley* (ND); 11 May 1891, *Cowan* (US); Genessee Mtn., *Eastwood 5452* (G, US); 1871, *Greene* (MBG); lat. 40°, 1862, *Hall* (PA); lat. 39°-41°, *Hall & Harbour 2* (FM, G, MBG, NY, PA); 1870, *Hulse* (NY); Tongre Creek, *Purpus 131* (FM); 1876, *Will* (PC); Clear Creek, *Wolf 92* (NY, US); *Wolf & Rothrock 92* (PA).

NEW MEXICO.—COLFAX CO.: Eagle Nest Lake, *McKelvey 2411* (US); 19 mi. e. of Taos, *Wiegand & Upton 3243* (MBG, NY); 1.5 mi. e. of Therma, *Wilkens 2449* (US). LINCOLN CO.: Jicarilla, 1933, *Walcott* (US). RIO ARRIBA CO.: below Tierra Amarilla, *Eggleston 6492* (G, MBG, NY, US); Chama, *Standley 6782* (US). SAN JUAN CO.: Chuska Mtns., *U. S. Geol. Survey 138* (G). SAN MIGUEL CO.: e. of Las Vegas, 2 June 1901, *Cockerell & Cockerell*, and between Las Vegas and San Ignacio, May, *Cockerell* (US); Las Vegas Hot Springs, 18 May 1902, *Sturgis* (G, NY). COUNTY NOT DETERMINED: *Kern* (PA); 1869, *Palmer* (PA).

Arizona.—coconino co.: Grand Canyon National Park, July 1933, *McHenry* (US); Bright Angel, *Tidestrom 2369* (US). mohave co.: Buckskin Mtns., *Jones 6056y*, and *Tidestrom 2373* (US).

Idaho.—ada co.: Boise, *Clark 89* (FM, G, MBG, NY, PC, UM, US), and May 1881, *Wilcox* (G). blaine co.: Ketchum, *Broadhead* (PC); 9 mi. n. of Ketchum, *Cronquist 2416* (MBG); Ketchum, 23 June 1892, *Mulford* (MBG, NY, UM); Mt. Hyndman, *Thompson 13614* (MBG, NY, PA). boise co.: Centerville, *Johnson* (US); Dry Buck, *Macbride 855* (FM, G, MBG, NY, PC, UM). clark co.: Spencer, *Cronquist 1280* (MBG), and n. w. of Kilgore, *1442* (MBG); Kilgore, *Rust 766* (US); Beaver Canyon, *Rydberg 2650* (NY), 13 July 1880, *Watson* (G), and *Shear 3008, 3042* (NY). custer co.: Bonanza, *Smith 31* (G). elmore co.: Trinity, *Macbride 589* (G, MBG). fremont co.: Cave Falls, *Cronquist 1746* (MBG); Buffalo River, *Jones 5237* (G); Henry Lake, *Payson & Payson 1967* (G, MBG, NY), and *Rydberg & Bessey 4099* (G, NY). idaho co.: "Camp Chopunnish," 27 May 1806, *Lewis & Clark*[26] (PA type). kootenai co.: Lake Couer d'Alene, June and July 1892, (FM, UM); Santianne Creek, *Leiberg 1057* (FM, G, NY, PC, US). latah co.: Moscow, *Abrams 542* (NY, PA), 6 May, 2 and 20 June 1894, *Henderson* (US), 20 Mar. 1928, *Siemens* (PA). nez perce co.: Forest, *Brown 5* (MBG, ND, NY, UM, US); Big Potlatch River, *McDougal 320* (FM); June 1892, *Sandberg* (MBG), and Sept. 1892 (UM); Big Potlatch River, *Sandberg, MacDougal & Heller 320* (FM, G, MBG, NY, US). washington co.: Middle Fork, Weiser River, *Jones 6131* (MBG, PC), and Seven Devils Mtns., *6133* (PC); Payette National Forest, 8 June 1911, *Miles* (US). county not determined: Soldier Mtns., *Henderson 3365* (US); *LeRoy* (NY); Cooper's Warm Springs, 20 July 1892, *Mulford* (MBG, NY).

Utah.—cache co.: Logan Canyon, *Mulford 231* (MBG, NY). carbon co.: 10 mi. e. of Sunnyside, *Graham 9537* (FM, G, MBG); Scofield, 24 June 1904, *Jones* (MBG, PC, US). daggett co.: 0.5 mi. w. of Green Lakes, *Hermann 4876* (MBG), and *Williams 597* (MBG, NY). duchesne co.: s. w. of Moon Lake, *Graham 9314* (G, MBG). kane co.: Pahreah, 1882, *Siler* (PA). salt lake co.: Little Cottonwood Canyon, *Garrett 1384* (G), and Big Cottonwood Canyon, *1385* (US); Alta, 7 July 1910, *Jones* (PC, US), and *Rydberg 6861, 6861a, 6862* (NY); s. e. of Silver Lake, *Rydberg & Carlton 6432, 6453* (G, NY, US). san juan co.: Abajo Mtns., *Goodman & Hitchcock 1382* (FM, G, MBG, NY, PA, UM), *1476* (FM, MBG), and La Sal Mtns., *1476* (G, MBG, NY, PA, UM); Elk Ridge, *Maguire & Redd 1796* (ND), and La Sal Ranger Station, 1801, (MBG); La Sal Mtns., *Purpus 6626* (MBG, PC, US); Abajo Mtns., *Rydberg & Garrett 9241* (NY, US). san pete co.: Wasatch Plateau, *Harris C25797* (PA, UM), *C25830* (UM), Ephraim Canyon, *C26492* (UM), Ephraim Plateau, *C27708* (MBG, UM), and Great Basin Experiment Station, *C29580* (FM, UM); Wasatch Mtns., *Pennell & Schaeffer 22734* (PA); Ephraim Canyon, *Tidestrom 292, 1341* (US). sevier co.: Fish Lake, *Dixon 541* (FM); Fish Lake National Forest, *Eggleston 10331* (US); Otter Creek Canyon, 17 July 1882, *Shock* (PC); s. of Glenwood, *Ward 134* (FM, MBG, PA, US). uintah co.: Uintah Mtns., *Goodding 1264* (G, MBG, NY, US); 15 mi. n. of Vernal, *Graham 6308* (FM, MBG), Little Lake, *8243* (G, MBG), and Mosby Mtn., *8344* (MBG, US). utah co.: Aspen Grove, *Garrett 3374* (NY); American Fork Canyon, *Jones 1351* (NY, US), and Soldier Summit, *5601b* (US). wasatch co.: Horse Creek, *Graham 9235* (FM, G, MBG). county not determined: Uintah Mtns., *Langille 131* (US); American Fork Canyon, *Leonard 122* (NY); Uintah Mtns., 19 July 1873, *Porter* (PA); Wasatch and Uintah Mtns., July 1869, *Watson* (G, NY, US).

Washington.—douglas co.: Waterville, *Whited 1211* (US). ferry co.: Hell Gate, *Pearsall 876* (NY). spokane co.: Spokane, May 1893, *Sandberg & Leiberg* (FM, UM), and Hangman Creek, *14* (G, MBG, NY, PA, US); Dishman, *Stillinger 20* (US); 20 June 1884, *Suksdorf* (FM, NY, PA), *229* (G). whitman co.: s. of Pullman, 6 May 1928, *Bransford* (PA); Pullman, *Elmer 1003* (UM, US), and *1570* (MBG), 17 July 1892, *Henderson* (NY, UM), *Jones 1247, 1249* (G), and 9 June 1893, *Lake* (MBG); 5 mi. e. of Wawawai, *Maxson 43* (MBG); w. of Colfax, *Parker 348, 601* (UM); n. of

[26] Erickson in Madroño 6:259-260. 1942.

Pullman, *Pickett 38* (UM), and Pullman, *271* (MBG); Pullman, 10 May 1893, *Piper* (UM), 19 May 1893 (G, MBG, NY), *1453* (G, NY, UM, US), and May 1901 (NY); Kaniak Butte, *St. John 6073* (NY); Pullman, *St. John 9615* (G, MBG, NY, PA), and *St. John & Parker 5917* (G, MBG, NY); between Pullman and Armstrong, *Weber 2036* (MBG); Pullman, 19 May 1893, *Williamson* (PA). COUNTY NOT DETERMINED: 1883, *Vasey* (US); *Wilkes 556* (NY).

OREGON.—BAKER CO.: Baker City, 11 June 1902, *Jones* (PC), and Hereford, *25299* (MBG, PC). GRANT CO.: Austin, *Gale 129* (G, MBG, US), and *Henderson 5451* (G, MBG); 10 mi. n. of Seneca, *Thompson 11922* (MBG, NY). HARNEY CO.: Emigrant Creek, *Peck 3805* (FM). UMATILLA CO.: 8 mi. w. of Meacham, *Sherwood 205* (FM); Kamela, *Heller 10129* (FM, G, PA, US). WALLOWA CO.: Chico, *Jardine 222* (US); 23 mi. above Imnaha, *Peck 17622*, and 22 mi. above Imnaha, *18121* (NY); Horse Creek, *Sheldon 8355* (NY, US). COUNTY NOT DETERMINED: Blue Mtns., *Cusick 374* (FM), *1851* (FM, MBG, ND, UM, US), and *3232e* (UM); Blue Mtns., *Douglas* (G, NY); *Geyer 313* (G); Blue Mtns., 25 May 1885, *Howell* (FM, G, NY, PA, UM, US); Wenaha National Forest, *Lawrence 139* (US); 1873, *Nevius* (G); Clear Water, *Spalding* (G).

The degree of pubescence of the young plants appears to show a general relation to latitude, plants from Washington and Oregon being densely hirsute, while in the southern part of the range they may be nearly glabrous. The variations in other characters, such as degree of division of the leaves and width of the ultimate divisions, show no evident geographical relationships; indeed there appears to be considerable variation within each colony, and aside from the variety *Scottii* with its simply pinnate leaves, and *arizonica* with its extremely filiform leaf-divisions, the writer is unable to recognize distinct varieties.

16a. Clematis hirsutissima var. **Scottii** (Porter) Erickson, n. comb.

C. Scottii Port. & Coult. Syn. Fl. Colo. 1. 1874; James in Jour. Cincin. Soc. Nat. Hist. 6:119. 1883; Kuntze in Verh. Bot. Ver. Brandenb. **26**:179. 1885; Britt. & Br. Ill. Fl. **2**:70. 1897; Howell, Fl. Northwest. Am. 9. 1897; Britt. Man. 422. 1901; Coult. & A. Nels. New Man. Rocky Mt. Bot. 198. 1909; Tidestr. Fl. Ariz. & N. Mex. 33. 1941.

C. Douglasii var. *Scottii* Coult. Man. Rocky Mt. Reg. 3. 1885; Gray, Syn. Fl. N. Am. **1**:8. 1895.

Viorna Scottii Rydb. Fl. Colo. 141. 1906; Britt. & Br. Ill. Fl. ed. 2, **2**:126. 1913; Woot. & Standl. Contr. U. S. Nat. Herb. **19** [Fl. N. Mex.]:257. 1915; Rydb. Fl. Rocky Mts. 291. 1917; Rydb. Fl. Prair. & Plains, 336. 1932.

Clematis plattensis A. Nels. in Bot. Gaz. **42**:52. 1906; Coult. & A. Nels. New Man. Rocky Mt. Bot. 197. 1909.

Leaves 2–5 pairs on primary stem, pinnate, 5–11-foliolate; leaflets simple or lobed, with distinct petiolules, lanceolate, sparsely pubescent; otherwise as in the species.

DISTRIBUTION: in the Bad Lands and Black Hills of South Dakota; and in the central and southern Rocky Mountain region.

SOUTH DAKOTA.—FALL RIVER CO.: 2 mi. n. of Hot Springs, *Barr* (MBG); Hot Springs, *Moore 1183* (UM), and *Rydberg 481* (G, NY, US). SHANNON CO.: Smithwick, 5 May 1941, *Barr* (MBG).

COLORADO.—CHAFFEE CO.: Salida, *Payson 1011* (MBG); Poncha Pass, *Ramaley & Johnson 14939* (NY). COSTILLA CO.: La Veta Pass, 28 Aug. 1936, *Alexander & Crehan*

(NY), Veta Pass, *Hicks & Hicks 6* (DU, NY, UM), and 1877, *Hooker & Gray* (G); Sangre de Cristo valley, 1898, *Horner* (G); 1 mi. w. of Veta Pass, *Ownbey 1383* (MBG, NY); Veta Pass, *Shear 3605* (NY), *3672* (US). CUSTER CO.: base of Snowy Range, 24 July 1872, *Redfield* (MBG), *403* (PA); n. of Lock Mtn., *Rollins 1230* (G, MBG, NY). FREMONT CO.: Cañon City, *Brandegee 27* (MBG, PA), 1872 (NY), and June 1877 (FM); Parkdale, 1898, *Horner* (G); Cañon City, *Nelson 10492* (MBG, NY, UP); 35 mi. w. of Cañon City, 27 July 1872, *Porter* (G, MBG, NY). HUERFANO CO.: Cuchara Camps, 18 Aug. 1923, *McAllister* (TEX); e. slope of La Veta Pass, *McKelvey 4825, 4842* (UM); s. e. of La Veta, *Rydberg & Vreeland 6230* (ND, NY), and 5 mi. s. w. of La Veta (NY). JACKSON CO.: Grizzly Creek, 26 July 1898, *Baker* (NY, PC). LA PLATA CO.: Ute Pass, 29 June 1886, *Trelease* (MBG). LAS ANIMAS CO.: 6 mi. s. of Trinidad, *Beckwith 52*, and Trinidad, *58* (NY); between Raton Pass and Trinidad, *McKelvey 2440* (US); 26 mi. n. w. of Trinidad, *Rollins 1807* (G, MBG, ND, NY). PUEBLO CO.: Greenhorn, *Bethel, Willey & Clokey 4107* (FM, MBG, NY, PA, UM, US); Rye, *Clokey 4108* (PA, US). SAGUACHE CO.: Alder, 17 June 1935, *Ramaley & Johnson* (TEX); 3 mi. s. e. of Poncha Pass, 8 Aug. 1937, *Wherry* (UP). COUNTY NOT DETERMINED: 1872, *Brandegee* (US); Arkansas Canyon, 1877, *Hooker & Gray* (G); Morton, 11 Sept. 1909, *Rusby* (NY); 1869, *Scoville* (US); Platte Canyon, 4 July 1885, *Smith* (PA).

NEW MEXICO.—COLFAX CO.: 10 mi. e. of Raton, *McKelvey 2437* (US); top of Raton Pass, *McKelvey 4891* (UM); Raton, *Mathias 508* (MBG); Vermejo Park, *St. John 177*, and Aug. 1894 (G); Raton, *Standley 6275, 13829*, and Ute Park, *13987* (US); Raton, *Tracy 50* (NY); 9 mi. w. of Cimarron, *Wiegand & Upton 3245* (FM); Woolton, 3 June 1900, *Williams* (US). COUNTY NOT DETERMINED: 1867, *Parry* (MBG).

UTAH.—SALT LAKE CO.: above Alta, *Rydberg 6861* (G).

Although there is a great deal of variation in the degree of compounding of the leaves and in the width of the ultimate divisions of the leaves in *C. hirsutissima*, this variety seems distinct from the species in having considerably wider leaflets and much less compound leaves.

16b. Clematis hirsutissima var. **arizonica** (Heller) Erickson, n. comb.

C. arizonica Heller in Bull. Torr. Bot. Club **26**:547. 1899.

Viorna arizonica Heller in Muhlenbergia **1**:40. 1904; Woot. & Standl. Contr. U. S. Nat. Herb. **19**[Fl. N. Mex.]:257. 1915.

Clematis Bigelovii var. *arizonica* Tidestr. Fl. Ariz. & N. Mex. 34. 1941.

Leaves 2–3 pairs on the primary stem, 2–3-pinnate, the ultimate divisions filiform, 1 mm. broad; otherwise as in the species.

DISTRIBUTION: in the region of Flagstaff, Arizona.

ARIZONA.—COCONINO CO.: Flagstaff, *Fulton 7215* (US), and *Hanson & Hanson A848* (MBG); 3 mi. e. of Flagstaff, *Hanson 848* (US); Walnut Canyon, *MacDougal 343* (G, NY TYPE, PA); Flagstaff, *Osborn 7902* (US), and *Purpus 19* (MBG, US). COUNTY NOT DETERMINED: de la Vergne Park, Aug. 1884, *Lemmon* (US).

This variety differs from the species also "in the rectangular instead of acute angled system of leaf branching," as Heller pointed out in his description.

17. Clematis Palmeri Rose in Contr. U. S. Nat. Herb. **1**:118. 1891.

C. Bigelovii James in Jour. Cincin. Soc. Nat. Hist. **6**:123. 1883, in part; Tidestr. Fl. Ariz. & N. Mex. 34. 1941, in part.

C. Douglasii var. *Bigelovii* Jones in Proc. Cal. Acad. II, **5**:614. 1895, in part.

Viorna Palmeri Woot. & Standl. in Contr. U. S. Nat. Herb. **16**:123. 1913; and in Contr. U. S. Nat. Herb. **19** [Fl. N. Mex.]:257. 1915.

Stems erect, simple or few-branched, about 10 dm. high; rather stout and woody, red below, yellow above, somewhat pubescent, especially at the nodes; leaves 5–6 pairs, pinnate with 5–11 divisions which are 3-lobed or 3-foliolate; leaflets 3–5-lobed or coarsely toothed, 3–7 cm. long, ovate, obtuse- to acute-tipped, glabrous or with a few scattered hairs, sometimes slightly glaucous, thin, not evidently reticulate; flowers solitary at the ends of primary stems or axillary branches from the uppermost 1 or 2 nodes, large, 3–4 cm. long, resembling in all characters those of *C. hirsutissima;* pedicels not greatly elongate in fruit; achene-bodies obovate, 4–5 mm. broad, inconspicuously rimmed, covered with rather long, appressed pubescence; achene-tails 4–5 cm. long, plumose with weak, pale brown or tawny hairs, loosely intertwined.

DISTRIBUTION: western New Mexico and eastern Arizona.

NEW MEXICO.—GRANT CO.: s. end of Black Range, *Metcalfe a2* (US). MC KINLEY CO.: Fort Wingate, 1883, *Matthews* (G). SANDOVAL CO.: Sandia Mtns., *Ellis 18* (MBG, NY, US). SAN JUAN CO.: Tunitcha Mtns., *Standley 7772* (US). COUNTY NOT DETERMINED: 1869, *Palmer* (US).

ARIZONA.—NAVAJO CO.: Fort Apache, 1890, *Palmer 600* (G, US).

C. Palmeri resembles *C. hirsutissima* very strongly in characters of the flower and fruit, but appears worthy of specific distinction because of its more robust habit, broad leaflets and nearly complete lack of pubescence.

18. Clematis Bigelovii Torr. in Pacif. Rail. Rept. **4**:61. 1856; James in Jour. Cincin. Soc. Nat. Hist. **6**:123. 1883; Kuntze in Verh. Bot. Ver. Brandenb. **26**:179. 1885; Tidestr. Fl. Ariz. & N. Mex. 34. 1941, in part.

C. Pitcheri var. *Bigelovii* Robins. ex Gray, Syn. Fl. N. Am. **1**:6. 1895.

Viorna Bigelovii Heller in Muhlenbergia **6**:96. 1910; Woot. & Standl. in Contr. U. S. Nat. Herb. **19**[Fl. N. Mex.]:257. 1915.

Erect, simple or few-branched from the uppermost nodes, about 5 dm. high; stems slender, glabrous or nearly so; leaves 3–4 pairs on the primary stem, pinnate with 7–11 primary divisions which are deeply 3-lobed or 3-foliolate; leaflets usually 2–5-lobed, more or less broadly ovate, blunt- or round-tipped, mucronate, 1–3 cm. long, glabrous, somewhat glaucous below, thin, not conspicuously veined; flowers solitary, terminating primary stems or branches, subcampanulate, 1.5–2.5 cm. long; sepals equalling or slightly exceeding the stamens, broadly lanceolate, thickish, finely and sparsely pubescent without, except the tomentose, slightly expanded margins; achene-bodies suborbicular or obovate, 4–5 mm. broad, inconspicuously rimmed, appressed-pubescent; achene-tails about 3 cm. long, glabrous or somewhat pubescent, not plumose.

DISTRIBUTION: canyons, New Mexico and Arizona.

NEW MEXICO.—BERNALILLO CO.: Sandia Mtns., *Bigelow 981* (G TYPE). GRANT CO.: Santa Rita del Cobre, 1877, *Greene* (G, ND); Silver City, 2 June 1880, *Greene* (FM), and June 1890 (PC); s. end of Black Range, *Metcalfe 1044* (FM, G, MBG, NY, UM,

US). MC KINLEY CO.: Fort Wingate, May 1885, *Shufelt* (US). SOCORRO CO.: Bear Mtns., May 1881, *Rusby* (FM, MBG, NY, PA, UM, UP). COUNTY NOT DETERMINED: 1869, *Palmer* (G); *Torrey Herb.* (NY).

ARIZONA.—NAVAJO CO.: Fort Apache, May 1893, *Hoyt* (NY).

The position of this species is problematical. In habit and vegetative characters it appears closely related to *C. Palmeri*. However, it resembles *C. Pitcheri* in the appearance of its flowers and in its non-plumose and fragile achene-tails, and was regarded as a variety of *C. Pitcheri* by Robinson.

DOUBTFUL SPECIES

Clematis rosea Smith in Abbot, Nat. Hist. Lepidopt. 201, *pl. 101*. 1797.

C. striata Rafinesque, Fl. Lud. 82. 1817.

INDEX TO SPECIMENS CITED

The numbers in parentheses are those assigned to species and varieties in this paper; those in *italics* are collector's numbers. The designation *s. n.* for unnumbered specimens has not been used except for species of which collectors have made both numbered and unnumbered collections.

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Clemens, Mrs. Joseph. *11585, 11585a* (9).
Clemens, Joseph, & Mrs. Joseph Clemens. *784, 785* (9).
Clements, F. E. (16).
Cletus, Bro. *98* (16).
Clokey, I. W. *2425* (9); *3050* (16); *4108* (16a).
Cockerell, T. D. A. (16).
Cockerell, T. D. A., & W. P. Cockerell. (16).
Commons, A. *s.n., 6* (1).
Congdon, Joseph W. (11).
Cooper, ——. (15).
Core, Earl L. *2708, 3662* (12).
Cornelius, ——. (14).
Correll, D. S. *115, 636* (1); *6402* (7); *1309, 1879, 1887, 2042, 2081, 5670, 5724* (10); *474* (11).
Correll, D. S., H. L. Blomquist, & K. H. Garren. *5137* (1).
Correll, D. S., & H. B. Correll. *9340, 9655, 10542* (10).
Cory, V. L. *11218* (7); *s.n., 8688, 12612* (9); *6992* (9a); *11468* (10).
Coulter, J. M. *642* (9a); (16).
Coville, F. V. (12).
Cowen, J. H. (16).
Craig, Moses. (14a).
Crampton, C. C. *225* (9).
Crandall, C. S. *s.n., 8, 10, 272, 334, 338, 1379* (16).
Crawford, Joseph. (1); (7).
Crockett, Geo. L. (7).
Cronquist, Arthur. *1280, 1442, 1746, 2416* (16).
Croom, H. B. *129* (7).
Cross, J. C. *5750* (7).

Curtis, M. A. (10); (11).
Curtiss, A. H. (1); (4); *s.n., 9, 4203, 4813, 6174, 9876* (7); *s.n., 8, 383* (10); (11); *s.n., 3, 6755, 6763* (15).
Cusick, Wm. C. *374, 1851, 3232e* (16).
Cuthbert, A. *681* (1); (4); *s.n., 560* (7); (8); (10).

Dahl, Inga. (14).
Daniels, Francis. *998* (16).
Davis, John. (1); *s.n., 906, 1413, 3748, 4171, 6400, 7330, 7330a* (9); (11).
Day, Marion. (14).
Deam, Chas. C. *s.n., 17, 5203, 7568, 11402, 17210, 18943, 20542, 38914* (1); *16801, 16919, 17044* (9).
Deane, Walter. (11).
DeChalmot, G. (1); (11).
Degener, Otto. *4968* (9).
Demaree, Delzie. *10714* (1); *4567, 6603, 6619, 6773, 6846* (5); *12900* (9); *4298, 11360, 16978, 20948* (10).
Demetrio, C. H. (9).
Denke, C. F. *1145* (1).
Denny, ——. (7).
Denslow, W. W. (11).
Dewart, F. W. (9); (16).
Didell, Mary W. (7).
Dixon, Helen. *541* (16).
Dixon, Royal A. *615* (9).
Douglas, David. (16).
Douglass, E. (9).
Dowell, Phillip. *6303* (11).
Draut, H. J. (16).
Drouet, Francis. *3, 1717* (9).
Drummond, Thomas. (9); *2* (10).
Ducker, Jessie. (14).
Dugès, A. *s.n., 342* (9a).
Duncan, Mrs. J. W. *1586* (9).
Dunham, William H. (1).
Durand, Elias J. (11).

Earle, F. S. (1); (7); *2023* (10); (16).
Earle, F. S., & C. F. Baker. (4); (7); *1583* (10).
Earle, F. S., & Esther S. Earle. *s.n., 243* (9a); *12* (10).
Earle, F. S., & S. M. Tracy. *256* (9a).
Eastwood, Alice. *5367, 5452* (16).
Eaton, A. A. *1043* (7); *s.n., 651* (15).
Eaton, D. C. (11).
Eaton, R. J. (11).
Eby, A. F. (1).
Eggert, H. (1); (2); (9); (10); *s.n., 63* (14a).
Eggleston, W. W. *5062* (7); *4551* (9); *6492, 10331, 10826, 11226* (16).
Ehrenberg, C. (9a).
Ellis, Charlotte C. *18* (17).
Elmer, A. D. E. *1003, 1570* (16).
Emory, W. H. (9a).
Engelmann, G. *163* (5); *s.n., 743* (9); (10).
Epling, C. (14a).
Erickson, Ralph O. *508, 509* (9); *514* (14); *507, 548* (14a).
Evermann, Barton W. (9).
Evers, Robert A. *188* (9).
Exploration Party. (4); (10).
Eyles, Don E. *1635* (10); *6819* (15).

Fendler, A. *2* (9a).
Ferguson, A. M. (6).
Fernald, M. L., & Ludlow Griscom. *2821* (10).
Fernald, M. L., & Bayard Long. *8268, 8712, 9321, 10265, 10266, 12078* (1); *3932, 3933, 6209, 6597, 8269, 10267, 10646, 10647, 10648* (10); *6208, 7840, 8271* (11).
Fisher, Geo. L. *3250* (7); *5086* (9); *5034, 38110* (10).
Fitzpatrick, T. J., & M. F. L. Fitzpatrick. (9).
Flaherty, J. S. (16).
Floodman, J. H. *465, 466* (16).
Fogg, John M., Jr. *13361, 14656, 15038* (1); *5514* (10); *13255* (12).
Forwood, W. H. *s.n., 54* (16).
Fosberg, F. R. *15495* (11).
Fox, O. O. *80* (9).
Francis, Mary E. *85* (15).
Franklin, L. Benjamin. (16).
Franklin, Marian S. (12).
Fraser, Samuel V. *279* (14).
Fredholm, A. *106, 5190* (7); *5792, 6500* (15).
Fremont, John C. *194* (14).
Frye, Wilbert. *805* (1).
Fulton, H. J. *7215* (16b).

Gale, Nettie P. *129* (16).
Garber, A. P. (7); (15).
Garrett, A. O. *1384, 1385, 3374* (16).
Gates, Frank C. *18683* (9); *16490* (14).
Gattinger, A. (2); (4); (5); (7); (9).
Geyer, Chas. A. (9); *313* (16).
Gibbes, Louis R. (4); (7); (10).
Gift, Janet (11).
Gilbert, F. A. *511* (12).
Githens, Thos. S. (10).
Glasson, M. (10).
Glatfelter, N. M. (5); (9); (11).

Gleason, H. A. *8759* (1); *8937* (5); *194; 9016* (9).
Godfrey, R. K. *3979, 5004* (1); *3746, 4448, 5235, 5291, 5342, 5383* (10).
Godfrey, R. K., & Thomas Kerr. *3853, 3931* (10).
Godfrey, R. K., & R. M. Tryon, Jr. *806* (1); *120, 663, 952, 975* (10).
Goodding, Leslie N. *295, 1264, 1454* (16).
Goode, ——. (15).
Goodman, G. J., & C. L. Hitchcock. *1382, 1476* (16).
Gordon, A. (16a).
Graham, Edward H. *6308, 8243, 8344, 9235, 9314, 9537, 9725* (16).
Grassl, Carl O. *3* (9a).
Graves, E. W. *2016* (9); *1242* (10).
Gray, Asa. (11); *s.n., 4182* (14).
Gray, Asa, & J. Carey. (1).
Gray, Asa, C. S. Sargent, J. H. Redfield, & Wm. M. Canby. (1).
Greene, E. L. (5); (16); (18).
Greenman, J. M. *3546, 3850* (9); *4883* (14a).
Gregg, Josiah. (10).
Griscom, Ludlow, & F. W. Hunnewell. *18829* (1).
Groth, H. A. *191* (9).
Gruver, Darwin. (9).
Guttenberg, Gustav. (12).

Hale, Josiah. (10).
Hall, Chas. H. (10); (11); (16).
Hall, Elihu. (9); (10); (16).
Hall, Elihu, & J. P. Harbour. *2* (16)
Hall, I. H. *s.n., 14* (11).
Hancin, John. *1735* (14).
Hanson, Herbert C. *688* (9); (10); *848* (16b).
Hanson, Herbert C., & Edna Ege Hanson. *A848* (16b).
Hapeman, Harry. (16).
Harper, E. T., & S. A. Harper. (16).
Harper, Roland M. *1059* (1); *s.n., 1408, 1463* (7); *795* (10).
Harris, B. B. *s.n., 523* (9).
Harris, J. Arthur. *C25797, C25830, C26492, C27708, C29580* (16).
Harshberger, J. W. *111* (1).
Hasse, H. E. (9); (10); (14a).
Havard, V. (9); *2* (9a).
Hayden, Ada. *9441* (9).
Hayden, F. V. (16).
Hayes, Sutton. *2* (9).
Heher, ——. *144* (14).
Heller, A. Arthur. *1003, 14044* (1); *1607, 1608* (6); *1607, 1608* (9); *847, 14082* (10); *1, 996* (11); *842* (12); *10129* (16).
Heller, A. Arthur, & E. Gertrude Halbach. *1003* (1).
Henderson, Louis F. *s.n., 3365, 5451* (16).
Henry, Howard K. *252* (11).
Hermann, F. J. *10380* (1); *4876* (16).
Hermann, F. J., & R. F. Martin. *951* (12).
Herzog, Th. (9).
Hexamer, A. C., & F. W. Maier. (10).
Hicks, G. H., & Mrs. G. H. *6* (16a).
Hilgard, E. (10).
Hill, Madeline. *122* (10).
Hill, R. T. *65, 66, 67* (6).
Hinckley, L. C. *s.n., 840* (9a).
Hitchcock, A. S. (7); (9); (10); *s.n., 2* (14); (15).
Hocking, G. M. (4).
Hodgman, Hattie M. (16).
Hoffman, R. (9).
Hollick, A. (11).
Holton, I. F. (9).
Hood, Samuel C. (15).
Hooker, J. D., & Asa Gray. (16a).
Hooks, ——, & —— Reed. (10).
Horner, Charlotte N. S. (16a).
Horsford, F. H. (1).
Houghton, H. W. *3872* (4).
House, H. D. *820, 1089, 2172, 2220, 4347* (1); *3382* (4); *4529, 5100* (10).
Hovey, ——. (15).
Howell, Arden, Jr. *748* (11).
Howell, Arthur H. *816* (4); *349* (9); *1054* (15).
Howell, John Thomas. (16).
Hoyt, R. W. (18).
Hubbard, G. W. *5* (9).
Hubricht, Leslie. *B1990, B1991, B1992, B1994* (10); *B2172* (14a); *B1993* (15).
Huger, A. M. *36* (1); *14* (15).
Hughes, J. A. *1121* (16).
Hulse, G. W. (15); (16).
Hulst, Geo. D. (11).
Hume, H. H., & E. West. (10).
Hunnewell, F. W. *4004, 4763* (12).
Huntley, Dorothy. *287* (1).
Hyams, M. E. (1); (10); (11).
Hyatt, James. (9).
Hynes, Mary (9).

Jardine, James T. *222* (16).
Jennison, H. M. (1).
Jermy, Gustav. *230, 627* (6); *231, 242* (9).
Johnson, G. V. (16).
Jones, G. N. *1247, 1249, 5237* (16).
Jones, Marcus E. *s.n., 147* (9); *s.n., 24,*

1351, 5601b, 6056y, 6131, 6133, 25299 (16).
Jones, Wyatt W. (16).
Joor, J. F. (9).

Kearney, Thos. H., Jr. *1348, 1503, 2005* (10); (11).
Keeler, Henry D. (15).
Keever, Catherine. *346* (1).
Kellerman, W. A. (9); (14).
Kellogg, John H. *s.n., 273, 1743, 1744* (9); *26193, 26193B* (10); *s.n., 1742, 15183* (14a); (15).
Kelsey, F. D. (16).
Kern, ——. (16).
Killip, E. P. *30998* (12); *32484* (13).
Kimmons, ——. (9).
King, Anna. *90* (1).
Kirkwood, J. E. *1412* (16).
Knight, Robert A. (7); (10).
Knight, ——. (16).
Knowlton, Clarence H. (11); (16).
Knowlton, F. H. (16).
Köhler, ——, & J. T. Rothrock. (15).
Kraus, E. J. (1).
Kriebel, Ralph M. *659* (1).

Lake, ——. (16).
Langille, H. D. *131* (16).
Langlois, A. B. *s.n., 2* (10).
Lavender, ——. *16* (4).
Lawrence, Wm. E. *139* (16).
Lea, Thomas G. (1).
Leavenworth, M. C. (15).
LeConte, John. (4); (11).
Lee, D. W. *107* (9a).
Lee, Marguerite T. (11).
Leeds, Arthur N. *2111* (1); *2133* (7); *s.n., 2566, 2888* (10); (15).
Leggitt, W. H. (11).
Leiberg, John B. *1057* (16).
Leidy, ——. (16).
Lemmon, J. G. (16b).
Leonard, F. F. *122* (16).
LeRoy, P. V. (16).
Letterman, George W. *s.n., 76* (9); (10); (14a); *s.n., 106* (16).
Lewis, J. F. (11).
Lewis, Meade. (11).
Lewis, Meriwether, & William Clark. (16).
Lewis, W. H., Jr. (11).
Lighthipe, L. H. *195* (7); *582, 583* (10).
Lindheimer, F. *s.n., 57, 383, 624, 625, 627, 655, 656, 657, 658* (6); *5* (7); *s.n., 5, 383, 384, 627, 654, 655, 657* (9); *1, 4* (10).
Livingston, R. B. *186* (16).
Lloyd, C. G. (1).
Lloyd, Francis E. (4).
Lloyd, Francis E., & S. M. Tracy. *13* (10).
Lodewyks, Maude C. *249* (10).
Long, Bayard. *28285* (1); (10).

McAllister, F. (16a).
McAtee, W. L. *2179* (10); *3337* (11).
Macbride, J. Francis. *589, 855* (16).
McCarthy, G. (1); (7); *s.n., 1, 7, 18* (10); (11).
McDonald, F. E. (9).
MacDougal, D. T. *283, 320* (16); *343* (16b).
MacElwee, Alexander. (7).
Macfarlane, J. M. (7); (10).
McFarlin, James B. *s.n., 4843* (7); *4466* (15).
McGregor, E. A. *6* (10).
McHenry, D. E. (16).
McKelvey, Susan Delano. *2411, 2440A, 4803* (16); *2437, 2440, 4825, 4842, 4891* (16a).
Mackenzie, G. *181* (9).
Mackenzie, Kenneth K. (9); *511* (10); *365* (12).
Maguire, Bassett, & J. D. Redd. *1796, 1801* (16).
Marsh, Ernst G. *193* (9a); *324* (10).
Martin, R. F., & C. O. Erlanson. *32* (12).
Massey, A. B. *2017, 3853* (3).
Masters, ——. (14).
Mathias, Mildred. *832* (14a); *372* (16); *508* (16a).
Matthews, A. C. (10).
Matthews, W. (17).
Maxson, S. S. *43* (16).
Mead, Samuel B. (9).
Mearns, Edgar A. *1428* (10); *s.n., 196, 839, 861, 1020, 1460* (16).
Meehan, Thomas. (1); (9); (16).
Meredith, H. B. (11).
Merriam, C. Hart. (1).
Merriam, C. S. (11).
Merrill, Elmer D., & E. N. Wilcox. *760* (16).
Merrill, Geo. M. *584, 696* (9).
Merrill, Geo. M., & Wm. A. Hagan. *403, 508* (9).
Metcalfe, O. B. *a2* (17); *1044* (18).
Miles, Lee O. (16).
Miller, G. S. (1).
Miller, L. C. (9).
Milligan, J. M. (9).
Mills, Ralph G. (9).
Millspaugh, C. F. *864, 4103* (1).
Mitchell, Gladys E. (10).

Mohr, Chas. (1); (8); (10); (15).
Mohr, Mary, & E. Mohr. (9).
Moldenke, H. N. *4192* (1); *1219, 10430* (10); *6811, 6876* (12); *217, 640* (15).
Moore, J. Percy. (16).
Moore, Clarence E. *B30* (10).
Moore, D. M. *330081* (10).
Moore, Geo. (5); (9).
Moore, John W. *1183* (16a).
Moore, John Adam, & Julian A. Steyermark. *3096, 3382, 3590* (9a).
Morris, E. L. *s.n., 116* (1).
Morris, O. M. (9).
Moyer, Lycurgus R. (16).
Muehler, C. H. *8001* (9a).
Mueller, C. H., & M. T. Mueller. *36* (9); *473, 474* (9a).
Mueller, Otto E. (1).
Muenscher, W. C. *11486* (16).
Mulford, Isabel. *s.n., 231* (16).
Munson, ——, & ——Hopkins. (6); (9).
Murrill, W. A. (7); (10); (11); (15).
Myers, S. E. (9).

Nash, Geo. V. *611, 1466, 1890* (7); *559* (15).
Nealley, G. C. *378* (9); (9a); *s.n., 52* (10).
Neeley, Egbert. (9).
Nelson, Aven. *s.n., 202, 9564, 10442* (16); *8355, 10492* (16a).
Nelson, Aven, & Elias Nelson. *789, 5449* (16).
Nelson, E. W. *3876, 6168* (9a).
Nelson, N. L. T. *147* (16).
Nevius, R. D. (10); (16).
Normand, J. F. (9).
Norton, J. B. *s.n., 1, 1a* (9).

Ohlweiler, W. W. (9); (14a).
Olive, E. W. *1* (9).
Olney, S. T., & J. Metcalf. *1* (10).
O'Neill, Hugh. (7); *547* (10); (15).
Oosting, H. J. *s.n., 3634, 33137, 34692* (1).
Orcutt, C. R. *6003* (9).
Osborn, Ben O. *1014* (14).
Osborn, W. J. *7902* (16b).
Osterhout, Geo. E. (16).
Ownbey, G. B. *719* (14a).
Ownbey, Marion. *1383* (16a).
Oyster, J. H. (9).

Pace, L. (9).
Painter, R. H. *107* (9).
Painter, Joseph H. *859, 1251* (11).
Palmer, Edward. (4); *2, 7* (9); *4, 5, 6, 8, 123, 194* (9a); *7* (10); (15); (16); *s.n., 600* (17); (18).
Palmer, Ernest J. *s.n., 5879, 6352, 27011, 23782, 39285* (5); *9941, 12170* (6); *10627a, 27234* (7); *477, 697, 698, 1101, 2326, 5794, 6509, 9938, 10201, 10508, 11152, 11315, 13951, 14369, 15454, 15483, 17886, 21384, 23406, 25181, 25487, 27893, 29569, 34584, 36694, 42057, 43969, 44017* (9); *30510, 30679, 32165, 34160, 34553* (9a); *11152, 12729, 13129, 15049, 15067, 17471, 22439, 29756, 35535, 38527, 39842* (10); *21311* (14).
Palmer, Ernest J., & Julian A. Steyermark. *41068, 42144* (9); *41606* (10).
Palmer, William. *38, 38a* (1).
Palmer, William, & Paul Bartsch. (10).
Pammel, L. H. (9).
Pammel, L. H., & R. E. Blackwood. *4028* (16).
Pammel, L. H., & Ferd Reppert. *1236* (9).
Parcher, Wm. *s.n., 1513* (11).
Parker, C. S. *348, 601* (16).
Parks, H. B. *14508* (9).
Parks, H. B., & V. L. Cory. *13843, 23459, 23460, 23461* (6); *5682, 6220, 7425, 8526, 8687, 11218, 12610, 12611* (9); *6991* (9a); *20141, 22061, 22307* (10).
Parry, C. C. *s.n., 4* (9); *1, 82* (16); *1* (16a).
Parry, C. C., & Edward Palmer. *1* (16a).
Patterson, Harry N. (9); (15); *s.n., 168* (16).
Paulson, Fannie E. *29* (16).
Payne, J. E., & T. W. Morse. (9).
Payson, Edwin B. *379, 1118* (16); *1011* (16a).
Payson, Edwin B., & George M. Armstrong. *3365* (16).
Payson, Edwin B., & Lois B. Payson. *1967, 3844* (16).
Peacock, Bess R. *12* (9a).
Pearsall, John. *876* (16).
Pease, Arthur Stanley. (9).
Peattie, Donald C. *868, 870* (1).
Peck, Clarendon. (10).
Peck, Morton E. *3805, 17622, 18121* (16).
Pennell, Francis W. *2481, 2507, 11458* (1); *11412* (4); *10684, 11491, 11591, 19378* (5); *10365* (6); *10261* (9); *5554* (10); *2453* (11); *21463* (16).
Pennell, Francis W., & R. L. Schaeffer, Jr. *22087, 22321, 22734* (16).
Pepoon, H. S. *s.n., 1586* (9).
Perkins, Janet R. (15).
Peter, Robert. (1).

Pew, Shelba. *98* (1).
Phelson, P. J. (7).
Piatt, Emma C. (9).
Pickett, E. *38* (16).
Pickett, F. L. *271* (16).
Pieters, A. J. *36* (7).
Pilsbry, H. A. (6); (9).
Piper, C. V. *s.n., 1453* (16).
Pitcher, Zina. (9).
Plank, E. N. (5).
Plymale, Lewis. *613* (1).
Pollard, Charles Louis. *836, 1078* (10); *s.n., 186, 334* (11).
Pollard, Charles Louis, & Wm. R. Maxon. *522* (1).
Porter, Thos. C. (1); (16); (16a).
Powell, C. F. (10).
Price, Sadie F. (1a); (4); (7).
Pringle, C. G. *3648, 11911* (9a).
Prior, Alexander. (1).
Purpus, C. A. *472, 5233* (9a); *131, 6626* (16); *19* (16b).
Pursh, Frederick. (1).

Quaintance, O. L. *60* (7).

Ramaley, Francis, & K. Richard Johnson. *s.n., 14939* (16a).
Randolph, L. F., & Fannie R. Randolph. *671* (10); *143* (11).
Ravenel, Henry W. (10).
Read, G. (10).
Redfield, John C. *11670* (1).
Redfield, J. H. (11); *s.n., 403* (16a).
Reed, Minnie. (9).
Reverchon, J. *s.n., 1, 1484, 1684, 2962* (6); *s.n., 1, 2961* (9); *2919, 3704, 3704A* (10).
Reynolds, Howard C. *2877, 2940* (9).
Reynolds, Mary C. (7); (10).
Rhoads, A. S. (7); (15).
Richter, Leilet. (9).
Ridgway, Robert. (1).
Riehl, N. (14a).
Robinson, B. L. (9); *112* (10).
Rodgers, Leland. *37* (1).
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Explanation of Plate

PLATE 1

Clematis Fremontii var. *Riehlii* Erickson

From type specimen in the Missouri Botanical Garden Herbarium. Label reads, "mining region of Missouri (about Hillsboro), N. Riehl, 1847."

POPULATION SIZE AND GEOGRAPHICAL DISTRIBUTION OF CLEMATIS FREMONTII VAR. RIEHLII

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Population size has very important bearings on evolutionary processes in any organism. As Dobzhansky (1941, p. 169) has pointed out, however, estimates of population size are available for only a few plants or animals. Among plants, the only such estimates are those of Anderson (1936) on *Iris*, and Emerson (1939) on *Oenothera organensis*. This paper presents detailed distributional data for *Clematis Fremontii* var. *Riehlii*, and a preliminary estimate of its population size.

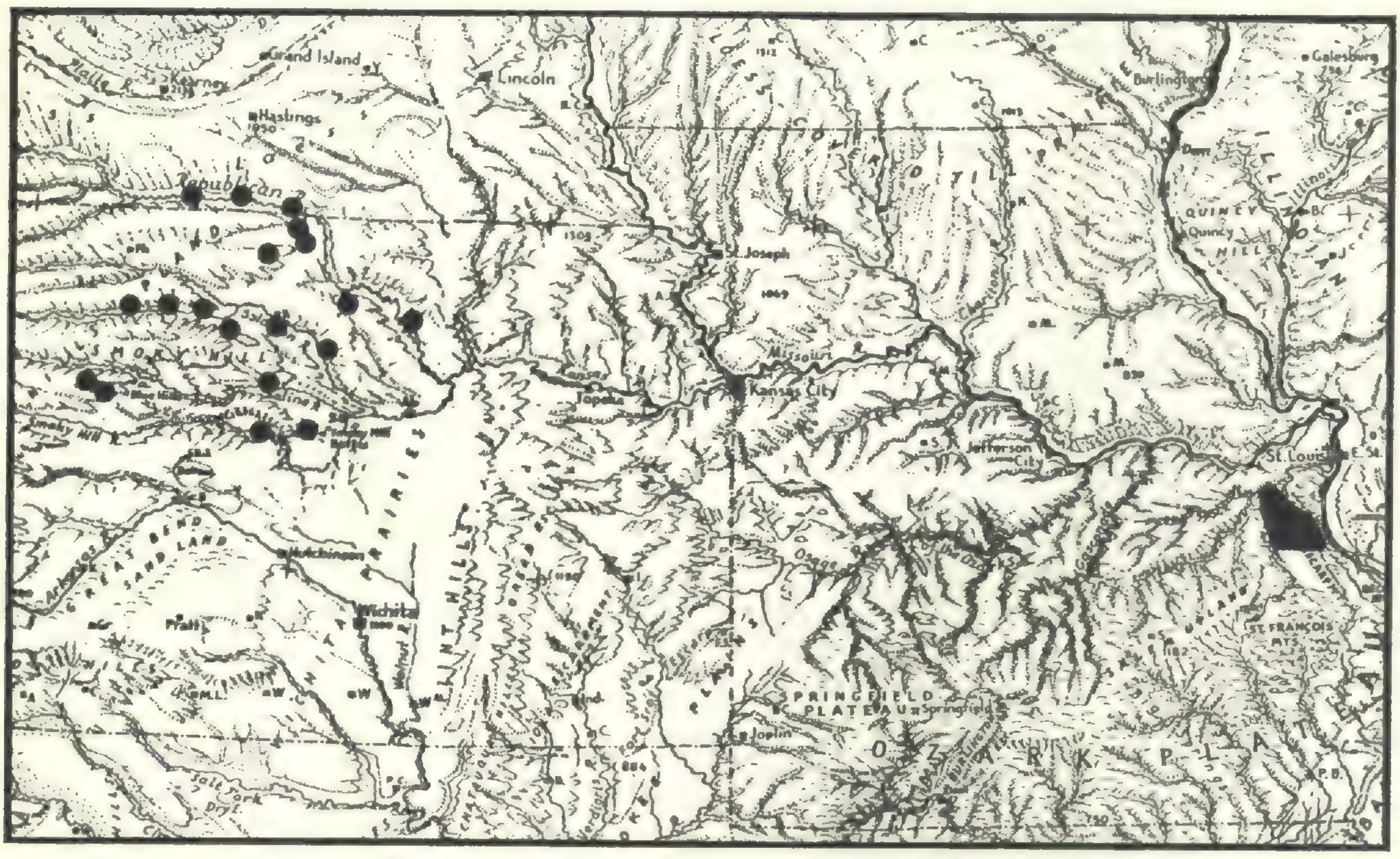

Fig. 1. Distribution of *Clematis Fremontii* (dots) and of *C. Fremontii* var. *Riehlii* (solid black). Base map by Erwin Raisz, reproduced from Atwood's 'Physiographic Provinces of North America', by permission of Ginn & Co.

Clematis Fremontii S. Wats., in its unrestricted sense, has a unique, disjunct distribution, being known from an area of roughly 10,000 square miles in north-central Kansas and adjacent Nebraska, and occurring again in eastern Missouri, where it is nearly limited to Jefferson County (fig. 1). A study of the available herbarium material has revealed some differences between the two branches of

the species. This point is discussed by Erickson (1943), and has been made the basis for proposing the name *C. Fremontii* var. *Riehlii* Erickson for the Missouri plants.

The limited range of *C. Fremontii* var. *Riehlii*, together with some other features of its distribution, and its vegetative characteristics, has recommended it for a detailed distribution study. It occurs exclusively on dolomitic glades, a well-marked type of habitat which has been described by Erickson, Brenner and Wraight (1942). The map which forms fig. 1 of that paper covers the range of *C. Fremontii* var. *Riehlii*, and was prepared as a preliminary to this study from tracings of aerial photographs. Fig. 2 of this paper is a reproduction of that map with the addition of the distribution data so far collected. The solid circles represent places in which *Clematis* has been seen. They have no numerical significance, some of them being based on finding of a single plant, others representing colonies of several thousand. The open circles are placed over glades on which *Clematis* has not been found after a reasonably thorough search. The plants are large enough and distinctive enough in appearance to be recognized at a distance of 200 or 300 yards. In many cases it has been possible to see *Clematis* on a glade without leaving the automobile, and it has been spotted by the use of field glasses. The leaves are thick and woody, so that the plants persist on the glades for over a year after flowering; this fact has made it possible to carry on some phases of field work throughout the year.

While it was often a simple matter to ascertain the presence of *Clematis* on a glade, more painstaking methods were used for the negative records. The plant has not been recorded as absent from a glade unless the glade has been visited on foot. For a small glade it was usually sufficient to walk from one end to the other; for a larger glade a zigzag course from top to bottom of the glade was followed, or two trips were made across it, one near the top edge, and the other near the bottom.

It can be stated with considerable confidence that *C. Fremontii* var. *Riehlii* does not occur outside the area outlined on the map (fig. 2). In Palmer and Steyermark's (1935, p. 542) catalog the plant is reported as occurring in St. Louis, Jefferson, Franklin, St. Francois and Washington counties. Its occurrence in Jefferson, Franklin and Washington counties has been repeatedly verified in this study. The St. Louis County record is undoubtedly based on the specimens collected by Letterman, labelled Allenton, and by Kellogg, labelled Allenton and Eureka (Erickson, 1943, p. 41). While the villages of Allenton and Eureka are in St. Louis County, the writer is convinced that the collections were made across the Meramec River in Jefferson County. An unsuccessful search has been made north of the Meramec, all along the outcrop of the Joachim formation, the only likely place. This view is supported by a half-dozen letters which Letterman wrote to Dr. Engelmann in the spring of 1875. It appears from these letters that Letterman had explored the southwestern part of St. Louis County quite thoroughly; and that he was on the look-out for the *Clematis*. On June 24 he states, "I do

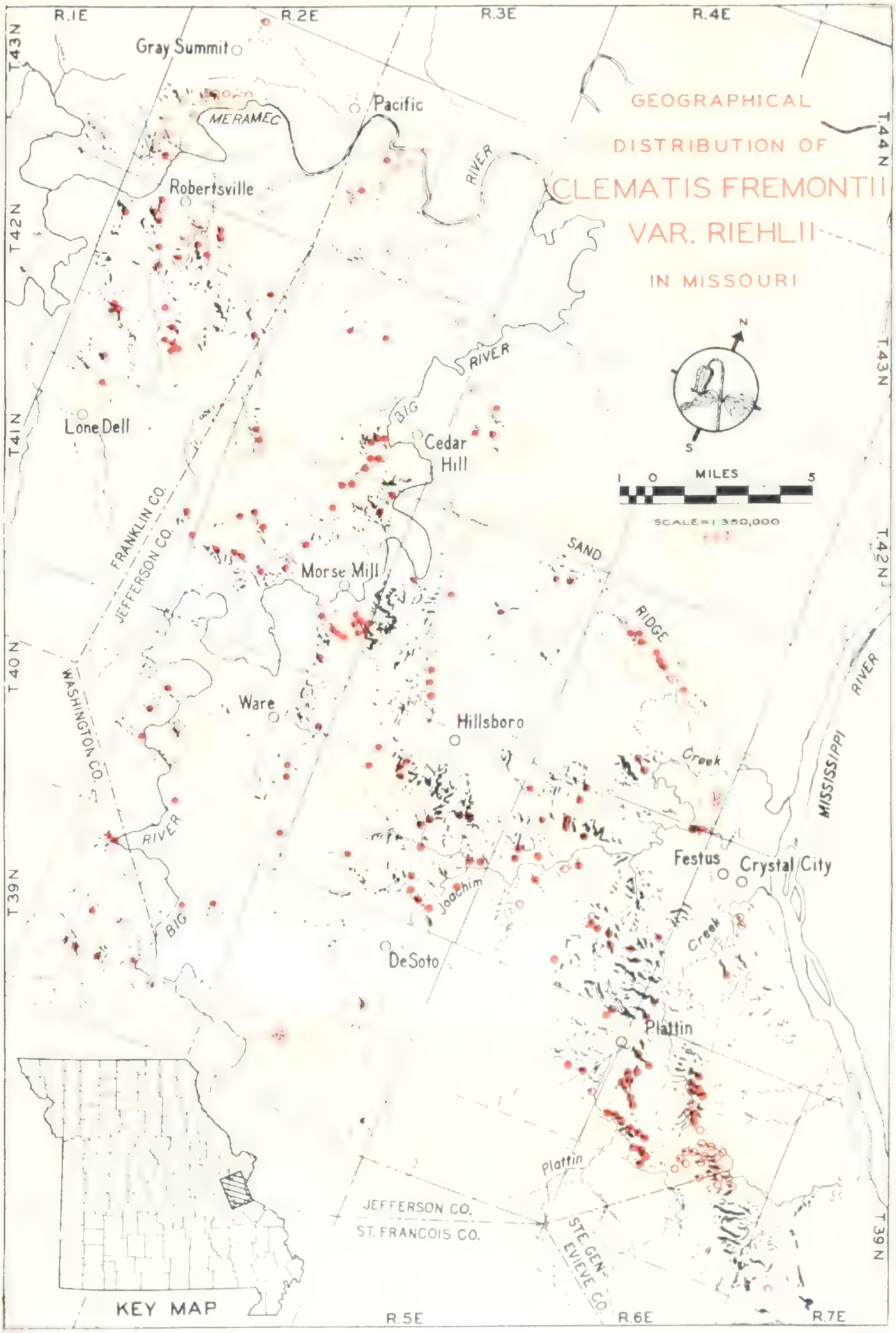

Fig. 2. Distribution of *Clematis Fremontii* var. *Riehlii*. Irregular black areas are glades; solid red circles, stations at which the plant has been seen; open red circles, glades on which *Clematis* has not been found after search.

Fig. 3. Mature plant of *Clematis Fremontii* var. *Riehlii* growing on glade shown below. Scale at right is in centimeters.

Fig. 4. Portion of glade 2 miles southwest of Robertsville, Franklin Co., Mo. (R.2E, T.42N, S.7, N.W.¼), showing plants of *Clematis Fremontii* var. *Riehlii* in foreground. Photographs taken April 27, 1942.

not remember having seen the Clematis [undoubtedly *C. Fremontii* var. *Riehlii*] in any of my rambles." He was fond of crossing the Meramec at Hunter's Ford and collecting in Jefferson County; and he later found the plant, his collections bearing various dates from 1880 to 1893. Kellogg's St. Louis County collections are probably to be interpreted in the same way.

The St. Francois County record does not appear to be supported by any herbarium specimen; *Clematis* has not been found on several glades in St. Francois County which have been visited in the course of this study. Steyermark has apparently collected the plant in Ste. Genevieve County.[1] It has not been possible to verify this record although three visits have been made to Beckett Hills for that purpose. Unsuccessful search has also been made for the *Clematis* in a number of other scattered localities which lie outside the area of the map.

Of the 160-odd positive records plotted in fig. 2, about 15 occur in places where no glades are indicated. In all of these cases the *Clematis* was found on glades which are quite small and were overlooked in tracing the photographs. The error arising from failure to investigate other unrecorded small glades is much less than the ratio of 15 to 160, because of the small numbers of plants on such glades as compared with the large numbers represented by many of the other dots.

The area occupied by the *Clematis* was outlined on the map (fig. 2) by connecting outlying dots with straight lines. By weighing a paper cut-out of the resulting polygon, the area was found to measure 436 square miles. For R.3E, T.41N, S.1-18, the total area in glades was measured by placing the photo tracings over a piece of paper ruled in small squares and counting the squares covered by the glade outlines. In these 18 square miles, the glade area is 1.6 percent of the total area. Assuming this percentage to be characteristic of the entire range of the *Clematis*, the glades on which it occurs occupy a total area of 7.0 square miles.

A few population density counts have been made. On a glade in R.6E, T.39N, S.4, 2½ miles east of Plattin, 1067 plants were counted in an area of 0.865 acre, a density of 794,000 plants per square mile of glade. In R.2E, T.42N, S.10, 2 miles southeast of Robertsville, 578 plants were counted in 2.33 acres, about three-fourths of a small glade. This represents a density of 160,000 plants per square mile of glade. Multiplied by 7.0 square miles, these densities give values for the total population of 5,550,000 and 1,120,000 respectively. The true value probably lies nearer the lower number.

In R.3E, T.41N, S.25, southeast of Morse Mill, the total number of plants was estimated as 5040. Ten-foot strips were laid out at 250-foot intervals across all the glades in the section, the plants were counted in these strips, and the estimate for the entire square mile was made from this sampling. Multiplying 5040 by 436 square miles gives 2,200,000 as the total population of *C. Fremontii* var. *Riehlii*, a

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[1] The specimens are labelled: Clematis Fremontii Wats., limestone glade in Beckett Hills, 2 mi. north of River aux Vases, Ste. Genevieve Co., No. 20926, Oct. 31, 1936, Julian A. Steyermark, Collector.

result which is of the same order of magnitude as the two estimates given above, although it was arrived at by a somewhat different method.

The absolute size of a population, however, does not have much meaning. Much more significant in evolutionary phenomena is Wright's "population number," the effective size of the breeding population (Dobzhansky, 1941). A number of factors besides absolute frequency are involved in the population number, such as (for this *Clematis*) size and proximity of the colonies, longevity of the plants, pollination radius, means and rate of seed dispersal, etc. An attempt to evaluate some of these factors is being made, and it is hoped that they may be discussed in a later paper.

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THE SEEDS OF TRADESCANTIA MICRANTHA

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Tradescantia micrantha Torrey is a curious, trailing, subsucculent species native to a small region in southeastern Texas. It is not closely allied to any other Tradescantias native to the United States but superficially at least it resembles *T. brachyphylla* of northeastern Mexico.

When the American species of *Tradescantia* were monographed[1] an unsuccessful attempt was made to obtain seeds of *T. micrantha*, since the size and shape of the seed and in particular the nature of the funicular scar has been found useful in delimiting natural groups of species. Thanks to the efforts of Mr. Robert Runyon, the well-known collector of Brownsville, Texas, seeds have at length

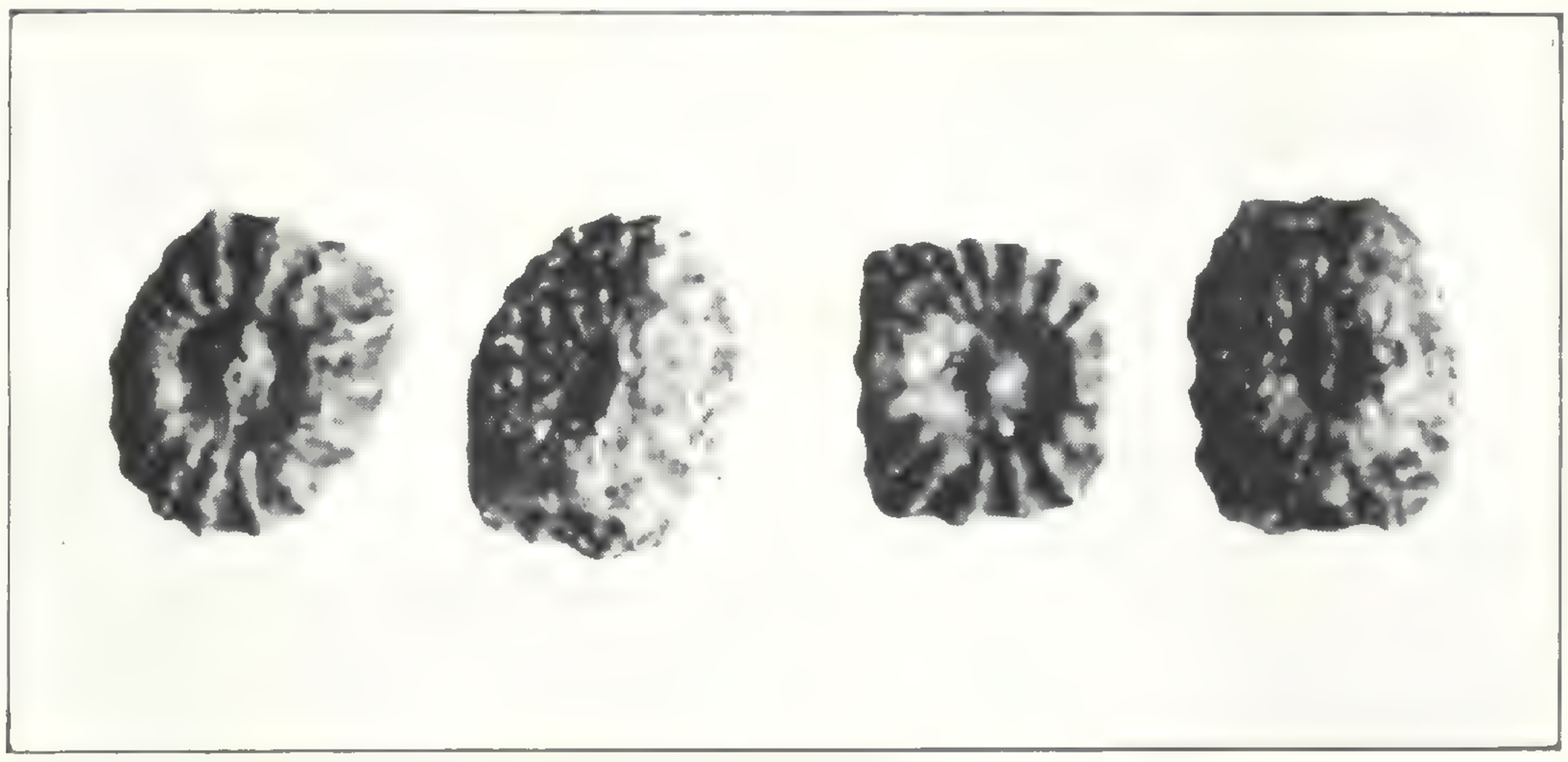

Fig. 1. Four seeds of *T. micrantha* greatly enlarged. Reading from the left, the first and third show the upper side of the seed, the second and fourth, the lower, the funicular scar being in the middle of the seed and extending vertically for about one-third the diameter in that direction.

(From photograph by Miss Eloise Pannell).

been obtained in quantity. Photographs showing the seeds greatly enlarged are reproduced in fig. 1. The seeds are broadly compressed-oblongoid to subtrigonal in shape, and the funicular scar, while linear, is less than half as long as the seed and may even appear subpunctate. Comparison with pl. VII of Anderson and Woodson's monograph[1] indicates a closer relationship to *T. Wrightii* than had previously been suspected. *Tradescantia brachyphylla*, on the other hand, is known to have very different seeds.[2] They are compressed subspherical with a funicular scar approximately as long as the seed. Any further discussion of the exact affinities of *Tradescantia micrantha* must await a general consideration of the whole problem, such as has recently been suggested by Woodson.[3]

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[1] Anderson, E. and R. E. Woodson. Contr. Arnold Arb. 9. 1935.
[2] loc. cit. p. 29.
[3] Woodson, R. E. Ann. Mo. Bot. Gard. **29**: p. 154. 1942.

ENVIRONMENTAL AND GENETICAL VARIATIONS IN YIELD AND COLONY SIZE OF COMMERCIAL YEASTS[1]

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One essential requirement of a good commercial baker's yeast is the ability to transform the maximum amount of nutrients in the fermentor into yeast in the shortest possible time. Yeasts vary in this property, and our first step in an attempt at yeast improvement included the collection of various strains, and the design of adequate tests for selecting the high-yielding ones.

This yield test was designed primarily to reject inferior cultures. The early data are comparative and indicative rather than absolute. In handling hundreds of cultures in the laboratory it is not feasible to duplicate plant conditions, and yields of the same yeast are relatively lower in the test-tube than in the plant. Our ultimate objective is to devise a test which will predict accurately the behavior of a yeast under plant conditions.

MEDIA AND METHODS

1. The Yield Test.—Broth was made by mixing carbohydrate and protein mashes obtained from the Anheuser-Busch yeast plant, in proportions which produced a medium about one half as concentrated as that used in the fermentors. This resulted in a medium containing 0.8 per cent sucrose and 0.7 per cent nitrogen-containing solids. It was neutralized by adding an excess of powdered calcium carbonate. After autoclaving for almost an hour to remove the heat-coagulable proteins, it was filtered with diatomaceous earth. A medium resembling that used commercially was designed to avoid the selection of strains of yeast not adapted to the ordinary commercial medium. Twenty cc. were placed in an 8 x 1-inch test-tube. This test-tube had previously received a small inverted gas tube, the lower opening of which was cut off at a slant to prevent a seal forming by contact with the base of the larger tube. After the tubes were autoclaved, approximately the same amount of inoculum was introduced into each tube with a spatulate needle. Within wide limits the amount of inoculum seems to make little difference in the yield. Twenty-four hours later the depth of the column of gas in the inverted tube was read to the nearest half centimeter. After 48 hours the contents were shaken up and 10 cc. were poured into a Hopkins vaccine tube and centrifuged for 20 minutes at 2000 r.p.m. The volume of the yeast was read off directly and recorded in hundredths of a cc. per 10 cc. of broth.

[1] This work was supported by a grant from Anheuser-Busch, Inc., St. Louis.

2. *MDY Agar.*—Our standard medium for plating yeasts is malt-dextrose-dried yeast agar of the following formula:

Malt extract	10.0%
Dextrose	.5%
Dried brewer's yeast	.5%
Agar	3.0%
$CaCO_3$	1.0%

3. *CM Agar.*—Carbohydrate protein mash agar was made simply by adding 3 per cent agar and 1 per cent $CaCO_3$ to the broth used in the yield test.

4. *Pr Agar.*—Prune agar was made by diluting the syrup from canned prunes with an equal volume of tap water and adding 1 per cent $CaCO_3$ and 3 per cent agar.

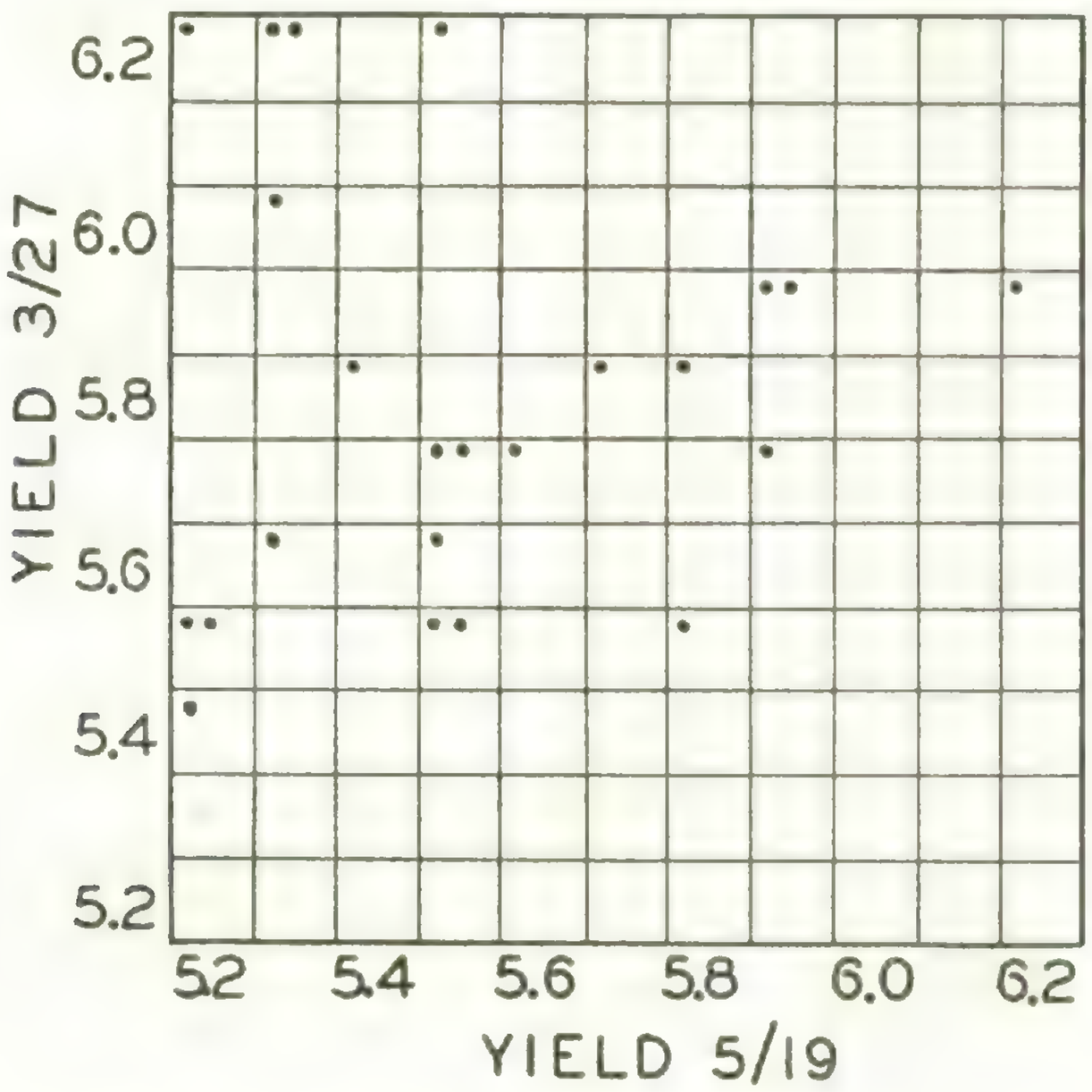


Fig. 1. Diagram showing correlation between yields of selected colony cultures in successive tests.

REPRODUCIBILITY OF DATA ON YIELD

A large number of duplicate tests with two different tubes of broth proved that the yields usually checked within .2 of a hundredth of a cc. when the tests were carried out at the same time. We have found on repeated trials that yeasts yielding less than 4.0 (hundredths of a cc.) usually remain in the low ranges and that those yielding 5.5 or more are not found in the lower brackets.

The data in fig. 1 show the yield of a group of different cultures tested on March 27, as compared with transfers from those cultures tested on May 19.

Although the correlation is not so high as might be desired, none of these relatively good yeasts was found on the second test to fall into the undesirable low-yielding category, i.e., in the ranges below 4.5. An interesting fact concerning the low-yielding yeasts is that the sediment in the centrifuge tube is usually much darker than that in the high-yielding ones.

PURIFICATION OF MIXTURES BY THE PLATING TECHNIQUE

Many yeasts are mixtures of genetically different kinds of cells which can be separated. The two principal techniques for effecting separation are (1) plating and (2) single-cell isolation. Cells are plated by spreading a loopful of a dilute suspension of the yeast over the surface of an agar plate. Individual colonies on the thinly seeded area of the plate usually originate from single cells. Single colony selection is more fruitful than single-cell isolation in separating mixtures, for it is possible to examine and compare several hundred colonies by spreading only a few plates. Colonies differing in shape and topography, selected from a plate and spread in turn on other plates, are generally found to repeat their respective characters, indicating that the original colonies were pure. The colonies must be rather well spaced if this technique is to be successful. The second method of single-cell isolation requires the selection of individual yeast cells with a micromanipulator. This is not at all difficult with yeast cells but plating yields so much more abundant results that it is the preferred method. In an unpublished study of variations of bacteria we made over 300 single-cell isolations of a bacterium with a relatively high mutation rate and found that plating gave results consistent with those obtained by single-cell isolations. Most bacteriologists studying variation agree with this conclusion.

HETEROGENEITY OF COMMERCIAL YEAST

Many commercial yeasts contain a heterogeneous mixture of biotypes, and this is especially true of old test-tube cultures. We recognize two general classes of colonies in these mixtures which we have called the primary and secondary types. The primary type usually seems to carry the desirable qualities. Various secondary genotypes are also present, but they are apparently deleterious rather than beneficial. Some of our data suggest that the commercial propagation of yeast considerably reduces the heterogeneity. The heterogeneity can be demonstrated by streaking on a rich substrate (such as MDY agar). The primary colonies from which the yeast derives its superior qualities are large, white, entire, smooth, hemispherical and opaque. The secondary colonies are generally much smaller than the primaries and are often brownish with lobed margins and rough surfaces (pl. 2, fig. a) or gray, translucent and flat (fig. b). Two typical small secondary colonies are also shown in pl. 3, fig. a. The secondary colonies often appear in a variety of types, indicating that they differ among themselves. The possibility that they may carry some valuable qualities seems unlikely for many

tests have revealed that these forms are extremely inferior in yield and fermentative ability. This view is further supported by the fact that most good commercial yeasts when fresh produce few secondary colonies. The secondary colonies sometimes have distinctive cell shapes. Rough colonies often have long, slender cells while smooth ones usually have ellipsoidal cells. However, there is much variation in cell size and shape in any colony. We have found a few extreme cases in which this character was very useful diagnostically.

AN EXAMPLE OF HETEROGENEITY IN A BAKERS' YEAST

A striking example of sharply bimodal heterogeneity in a bakers' yeast was discovered by plating a sample from a pound package of yeast. The colonies appearing in the plates shown in pl. 2, fig. b were of two kinds: typically large and opaque primary colonies, and flat, translucent, and gray secondary colonies. The cells of the primary colonies were of normal size, but those of the secondary colonies were generally small. Tests for yield revealed the following distribution:

Yield class range	*Primary colonies*	*Secondary colonies*
2.0 – 2.9	0	11
3.0 – 3.9	0	1
4.0 – 4.9	0	0
5.0 – 5.9	0	0
6.0 – 6.9	11	0
7.0 – 7.9	3	0

The two types of colonies appeared in about equal numbers on the plate, indicating that about half the package was made up of a distinctly inferior yeast. This is the only heterogeneous yeast which we have found containing two such sharply contrasted forms. More frequently a wide range of variation is encountered.

SELECTION WITHIN A CLONE

An attempt was made to determine if the primary colonies can be further subdivided into yeasts of high and low yield. The results are recorded graphically in fig. 2. On the horizontal scale are indicated the various class ranges in yield of hundredths cc. per 10 cc. of medium. On May 31 a commercial live dried yeast was plated on MDY agar and 16 large colonies selected and tested for yield. Thirteen colonies plated from the lowest-yielding culture (6.3) were tested on June 6a. On the same day (June 6b) 12 colonies originating from one of the highest-yielding colonies were tested, but no significant differences were revealed. This suggests that the primary colonies of the commercial yeast are all closely related genetically.

In any colony there are rather wide variations in cell size. Not unusually small colonies which produce poor yields contain an excess of small cells. An effort was made to determine if large and small cells from one colony produced high- and low-yielding cultures. On June 8, 6 single-cell cultures were made of

the large cells, and 4 single-cell cultures of small cells from the same high-yielding culture. No significant difference was found between these two groups, indicating that the variations in cell size are not necessarily indicative of genetical differences.

On June 10 tests a and b revealed that the highest- and lowest-yielding cultures from June 6a did not produce significantly different types. Also the c and d tests showed that the highest- and lowest-yielding colonies from June 6b did not result in differently yielding progenies. Finally, on June 15, 14 colonies selected from the highest-yielding colony in the June 10d test were found to be not significantly better than the original colonies.

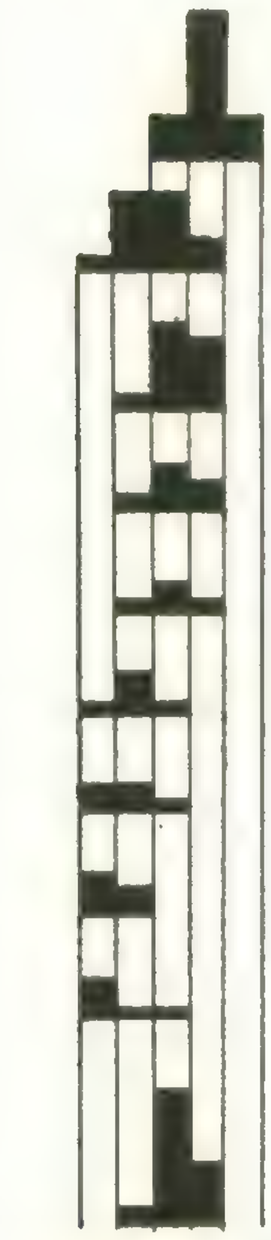
Throughout the record, it is clear that the day on which the tests were made, rather than the yield of the parent culture, affected the determination of the mode. The lowest-yielding group was obtained on June 10, the next on June 6, June 8, and June 15, and the highest-yielding group on May 31. Since the tests were made at room temperature, because of limitation of incubator space, it appears that if more accurate duplication were desired, it would be necessary to incubate the tubes. As has already been pointed out, the tests are only to eliminate inferior stocks, and while accurate temperature control is desirable it is not essential. Although temperature probably determines the position of the mode, the variation about the mode is apparently due to other local environmental conditions.

In the course of the experiment, 10 small secondary colonies were selected from various plates and tested along with the primary colonies. The two histograms (fig. 2b) show that most of these secondary colonies are distinctly inferior in yield. Secondaries were not present on all plates and when present usually made up less than 1 per cent of the total number.

In one series of selections the highest-yielding member of each set was successively chosen to produce the next culture generation. Selections were made serially from the following populations (a) May 31, (b) June 6b, (c) June 10d and (d) June 15. This intensive selection did not result in any improvement of the culture, indicating that the primary colonies all belong to one biotype.

Variation due to environmental differences usually have a range of from 0.5 to 1.0 hundredths of a cc. in a 10-cc. sample at any given temperature of incubation. The use of class ranges with a magnitude of .5 and the fact that all the samples usually fell in three classes make the environmental variations look much larger than was actually the case. The few samples in the outer ranges usually fell close to the central class. With many yeasts we have found that a dozen or more samples from one plate may all fall within a range of .2 hundredths of a cc. The yeast used in this experiment showed greater variations in a given determination than were usually encountered. This difference in the ranges of variability of different clones unfortunately means that a genetically significant variation in one yeast may not necessarily be significant in a second yeast.

It is clear that the secondary colonies yielding less than 5.0 are distinctly in-



DATE	SOURCE CULTURE	YIELD
May 31	Commercial yeast	Undet.
June 6a	May 31	6.3
June 6b	May 31	7.0
June 8	May 31 large cells	7.2
June 8	May 31 small cells	7.2
June 10a	June 6a	5.4
June 10b	June 6a	6.8
June 10c	June 6b	5.8
June 10d	June 6b	6.8
June 15	June 10d	6.5

a. THE EFFECT OF SELECTION WITHIN A CLONE ON YIELD.

b. COMPARISON OF THE YIELDS OF PRIMARY AN SECONDARY COLONIES.

Fig. 2. Series of histograms showing the frequency of yield in a series of selections from a yeast clone. See text.

ferior yeasts. These secondary colonies probably arise by mutation or segregation. Segregation, however, must occur rather rarely since spore formation in these strains does not normally occur except under special conditions.

COLONY SIZE ON VARIOUS MEDIA

Roughness and smoothness or other characters affecting the topography and morphology of the colony are easily recognized as stable genetical characters which readily distinguish different strains or variants in yeasts. It is a great advantage to be able to plate out cultures on agar and observe the distribution of

these different types. Although all the colonies on an agar plate may be readily recognized as being either rough or smooth they are never all of the same size. When the colonies are plated thickly they are generally small, apparently because they interfere with each other. At the edge of the seeding, where only a few colonies appear, they are usually larger. This type of size variation is purely environmental and has no genetic basis. It can be seen very clearly in pl. 3, figs. a and e.

The true dwarf colonies, which we have called secondary colonies, can be detected merely by their small size if the test is made under the proper conditions. When colonies are planted thinly, these secondary colonies remain small when compared to the primaries. Since the secondary colonies have been found to yield considerably less than the primaries, it is an especial advantage to be able to form some opinion of the distribution of primary and secondary forms in a culture merely by inspection of the colonies on an agar plate.

On a poor medium the situation is quite different. At the first transfer to a poor medium there may be no correlation between size of colony and yield. Fewer colonies appear following equal inoculation on a poor agar than on a rich medium, and the colonies that do grow vary greatly in size. The fact that the number of colonies is reduced proves that only a small fraction of the cells survive transfer to the inferior medium. Plate 3, figs. a, b, and c show agar plates on which equal numbers of cells were plated on MDY agar (pl. 3, fig. a), on CM agar (pl. 3, fig. b) and on Pr agar (pl. 3, fig. c). On the latter two media only a few colonies appeared, and they varied greatly in size. Twenty-four colonies on a CM agar plate were graded according to size, "A" indicating the largest and "F" the smallest size class. They were tested for yield with the results shown below.

Yield class range	*Colony Size*					
	Largest					*Smallest*
	A	B	C	D	E	F
4.5 – 4.9		1				1
5.0 – 5.4	1		3	1	2	
5.5 – 5.9		1	1	4	2	3
6.0 – 6.4					3	1

The four highest yielding cultures were obtained from colonies falling in the two smallest size categories. These results show that the differences in colony size on a poor medium do not result from true genetic differences in vigor. Only a few cells survive the shock of transplantation, and the surviving cells which are able to produce colonies do not fully recover from the shock of the transfer even after the colonies originating from the survivors have attained their full growth. However, a second transfer to the same medium makes the adaptation complete as far as can be judged from colony size.

Figure 3 is a record of variations in size of colonies after serial plating on CM, MDY, and Pr agar. Large, medium, and small colonies selected from CM plates, like those shown in pl. 3 fig. b, were transferred to CM medium. All produced

uniformly large colonies following this second transfer to the identical inferior medium, corroborating the view that the size differences shown on the first CM plate were not due to genetic differences in vigor. Transfer to MDY medium also produced uniformly large colonies. However, transfer from CM to Pr agar did not result in uniformity, but the plates made from large and small colonies both showed considerable variation in colony size. When large colonies from the first Pr plate were transferred to a second Pr plate only uniform large colonies appeared. Moreover, when the small colonies from the first Pr plate were transferred to a second Pr plate uniform large colonies resulted. This proves that transfer from CM to Pr produces shock just as transfer from MDY to either Pr or CM did. After two transfers on a specific poor medium, adaptation to this specific poor medium occurs which makes the culture capable of producing uniformly large colonies on the inferior substrate.

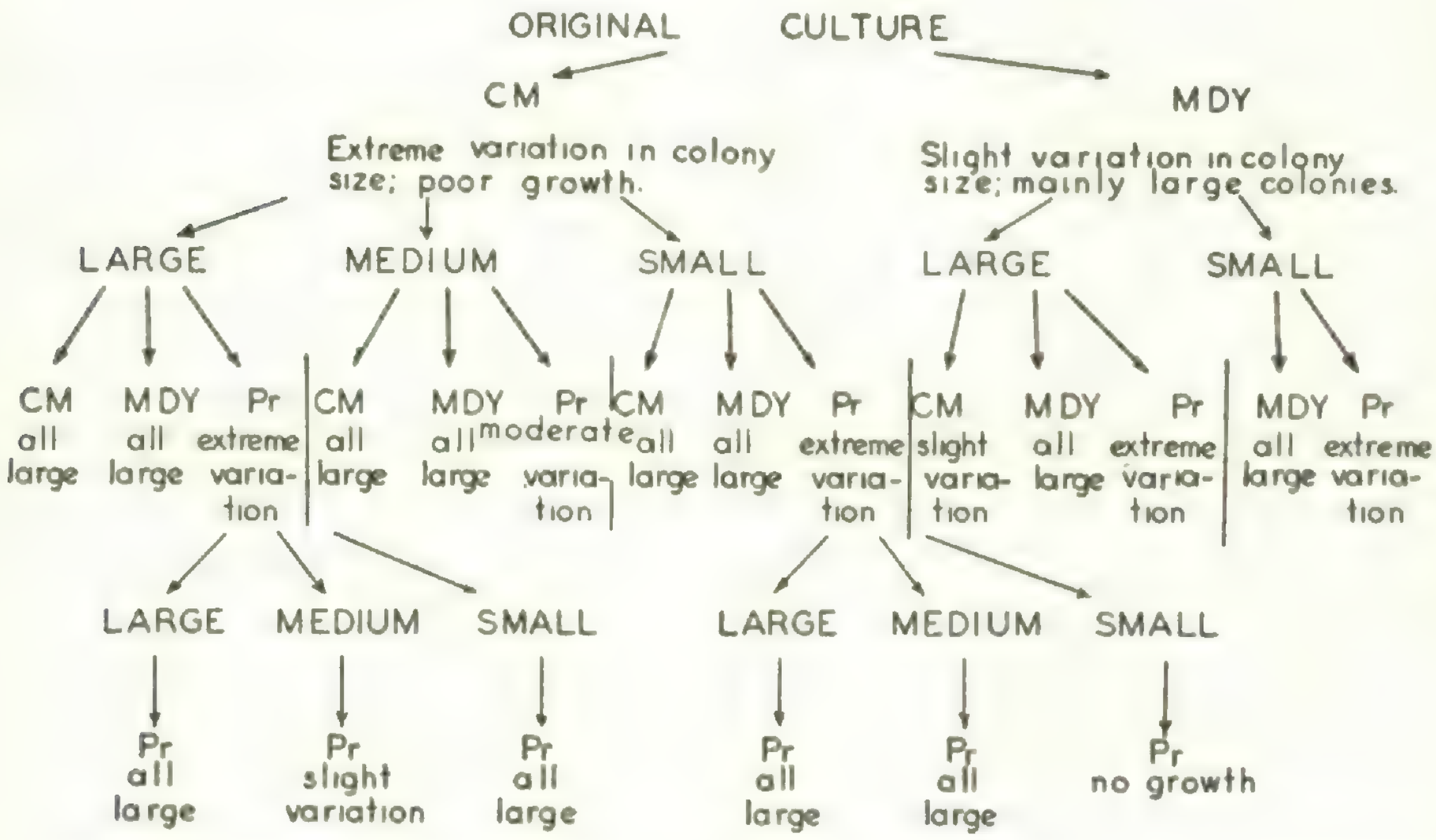


Fig. 3. Variations in colony size on MDY, CM, and Pr agars and the effects of selection of large and small colonies.

It is an especial advantage to be able to form some opinion of the distribution of primary and secondary forms in a culture simply by sowing an agar plate. However, primary and secondary colonies can only be distinguished when the culture is plated on a rich medium supplying all the necessary nutrients. Although one might expect that a medium lacking in certain essentials would be better adapted to making distinctions of this kind, on poor media there is so much reduction of size, probably due to the shock of the first transfer and from other causes, that the distinction fails. On the MDY medium two types are easily recognized. This does not imply that either the primary or secondary colonies are genetically uniform as a class. We have found in *Neurospora* that a good medium often con-

ceals minor genetical difference. The apparent difference between yeast colonies on a poor medium are artefacts.

These experiments prove that it is possible to distinguish high- from low-yielding yeasts by colony size provided a rich medium such as MDY is used. However, the potentially high-yielding cells do not necessarily produce the larger colonies when plated on inferior agar. One might expect that the differences between survivors after exposure to exceptionally adverse conditions would be due to true genetic differences, but it appears from these experiments that if the conditions are too severe the differences in colony size among the survivors is the result of a series of relatively unpredictable accidents and not indicative of hereditary vigor.

THE EFFECT OF GENETIC DIFFERENCES ON SURVIVAL UNDER ADVERSE CONDITIONS

Plate 2, figs. a, b, and c show the colonies appearing when the R strain of yeast is sown for the first time on MDY, CM, and Pr agar respectively. This R strain (R does not signify "Rough" but is merely a serial designation) is an exceptionally good baking yeast with a rather low yield but high baking strength. Subsequent analysis has shown that it is probably a single ascospore culture. The significance of this fact will be discussed in later papers.

Plate 2, figs. d, e, and f show the colonies appearing when the D strain is sown for the first time on MDY, CM, and Pr agar. This strain yields relatively higher than the R strain but has less baking strength, i.e., it requires longer to cause bread to rise. Genetic analysis has shown these two strains to be distinctly different. It is apparent that this genetic difference results in a larger number of D strain cells surviving the transfer. In this strain there are also many fewer variations in colony size on both the CM and Pr agars, which is in line with the view that the variations in colony size are proportional to the severity to the shock of transfer.

SUMMARY

A test which indicates the efficiency of a yeast in transforming nutrient materials into yeast cells has been developed and its reliability studied. Many commercial yeasts were found to produce two classes of colonies when planted on a good medium. We have called the large smooth colonies, primary colonies, and the small variable colonies, secondary colonies. The secondary colonies are low yielders. The distinction between primary and secondary colonies fails when yeasts are planted on poor media because the shock of transfer causes great variation in colony size.

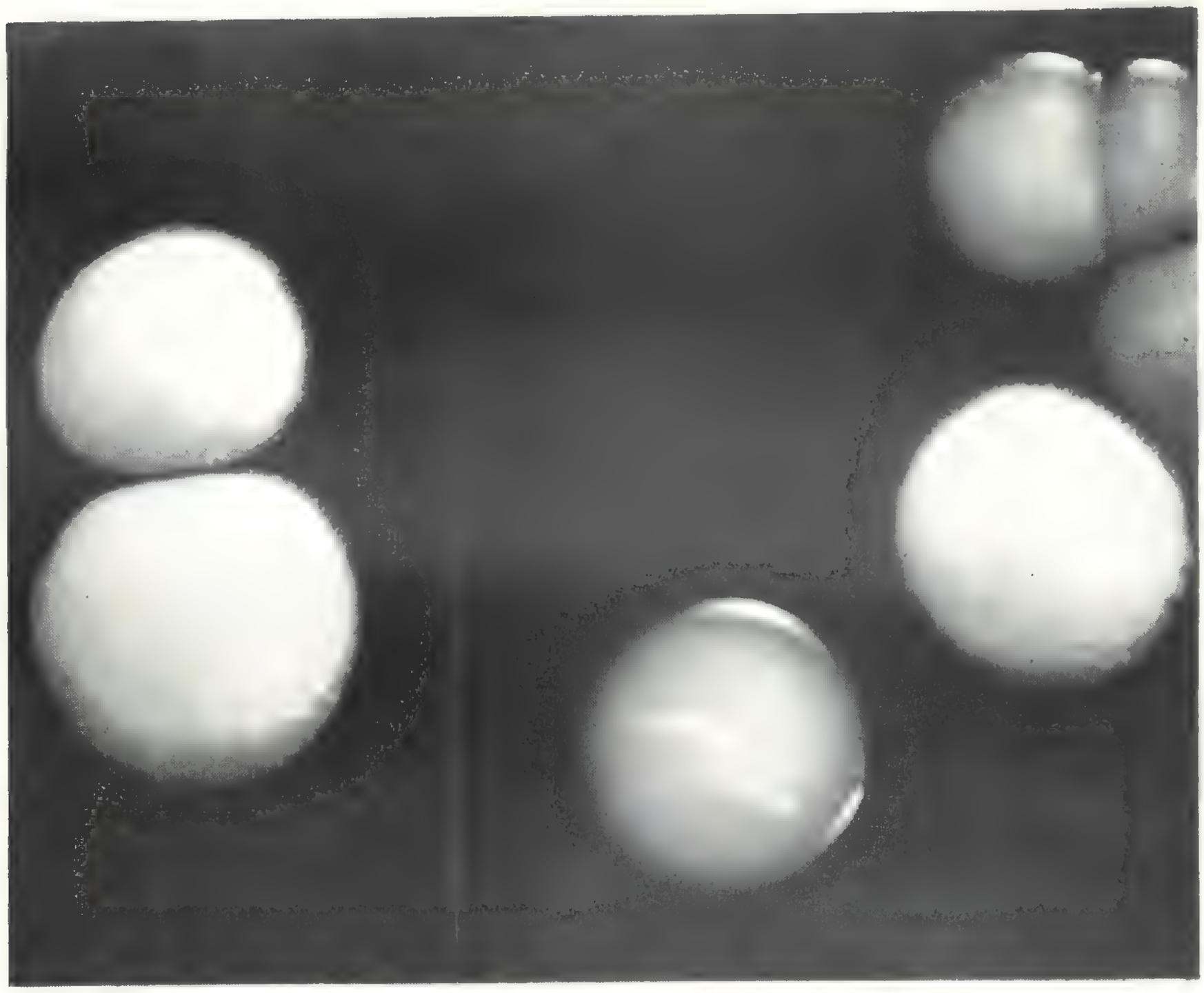
Explanation of Plate

PLATE 2

Fig. a. Typical large and smooth primary colonies with various small and rough secondary variants on MDY agar.

Fig. b. Large hemispherical white primary colonies and flat translucent gray low-yielding secondary colonies plated from a cake of commercial yeast.

a



b

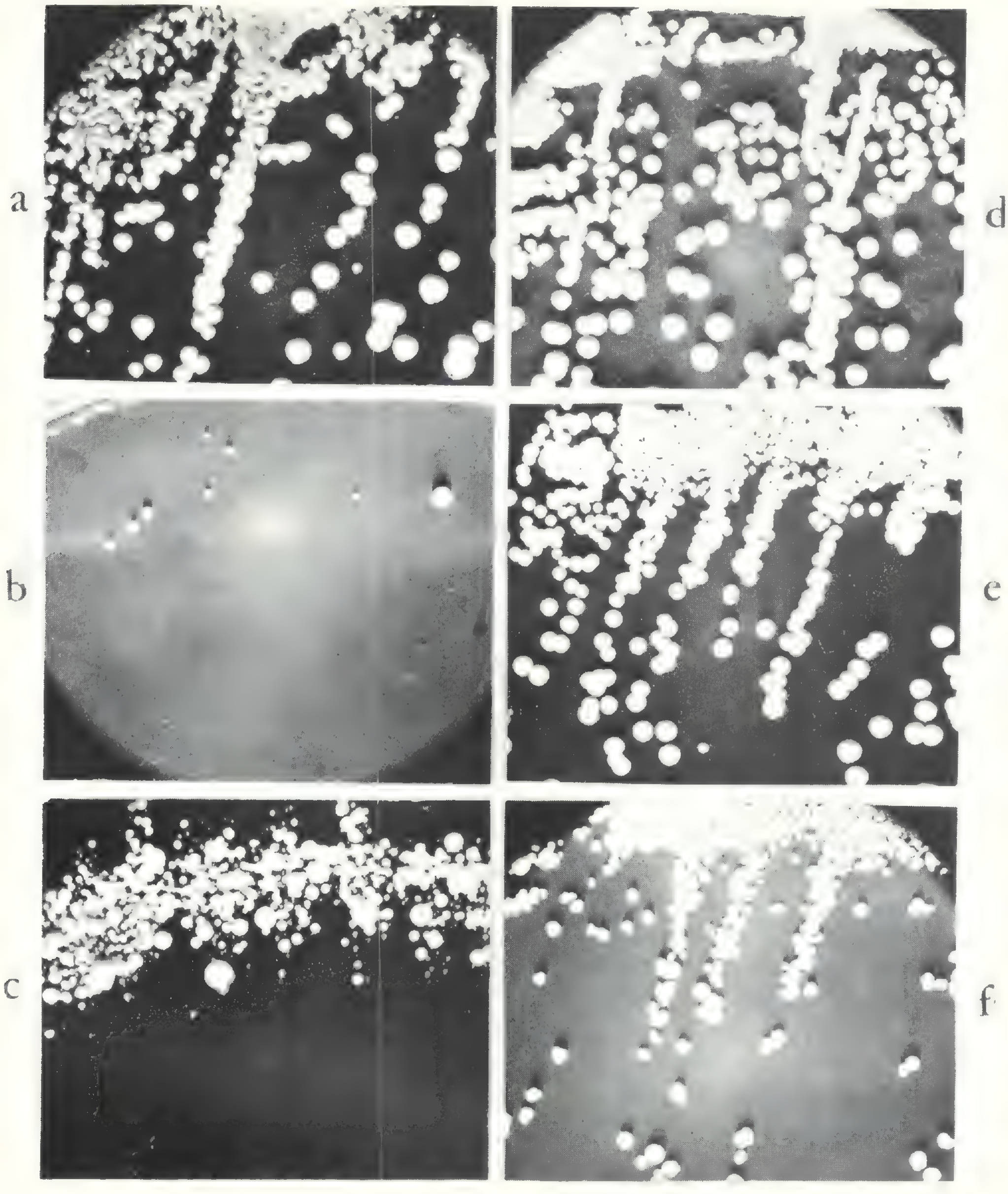
LINDEGREN & LINDEGREN—VARIATIONS IN YEASTS

Explanation of Plati

PLATE 3

Figs. a, b and c. Colonies of the R strain of yeast appearing after plating equal number of cells on MDY (a), CM (b) and Pr (c) agars. Two true secondary colonies appear on the MDY plate. On the CM plate there is appearing a great reduction in the number of colonies and much variation in size. On this plate variations in size bear no relation to yield.

Figs. d, e and f. Colonies of the D strain of yeast appearing on MDY (d), CM (e) and Pr (f) agars. This yeast is genetically different from the R strains and withstands the shock of transfer much more successfully.



LINDEGREN & LINDEGREN—VARIATIONS IN YEASTS

CONTRIBUTIONS TOWARD A FLORA OF PANAMA[1]

VII. Miscellaneous Collections, Chiefly by H. von Wedel, in Bocas del Toro

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Associate Professor, Henry Shaw School of Botany of Washington University
AND ROBERT W. SCHERY
Research Assistant, Missouri Botanical Garden
Instructor, Henry Shaw School of Botany of Washington University

BROMELIACEAE
(L. B. Smith)

Catopsis Berteroniana (Schultes) Mez. (*C. nutans* sensu L. B. Smith in Ann. Mo. Bot. Gard. **24**:180. 1937; non Griseb. 1864). Material at Stockholm

Fig. 1. *Catopsis micrantha* L. B. Smith

labelled *Tillandsia nutans* by Swartz is actually *Catopsis Berteroniana.* Later, I learned that the type of his *Tillandsia nutans* is in the British Museum and is equivalent to *Catopsis fulgens.*

Catopsis **micrantha** L. B. Smith, sp. nov. (fig. 1).—Planta masculina solum cognita, florigera fere 1 m. alta; foliis multis, erectis, ad 23 cm. longis, margine haud albis, ad basin versus plus minusve cretaceis; vaginis quam laminis longioribus sed haud distinctis; laminis late ligulatis, 4 cm. latis, late acutis, apiculatis, supra sparse subtus dense punctulato-lepidotis; scapo erecto, gracili; scapi bracteis sub-

[1] Issued March 22, 1943.

foliaceis, dense imbricatis; inflorescentia laxe ampleque tripinnatim paniculata; bracteis primariis suboblongis, late acutis, quam ramis multo brevioribus; ramis divergentibus, 2 dm. longis; spicis elongatis, laxe multifloris; bracteis florigeris late ovatis, quam sepalis brevioribus; floribus masculinis sessilibus, patentibus; sepalis asymmetricis, latissime obovatis, 2 mm. longis; petalis 3.5 mm. longis, albis; staminibus inaequalibus.—BOCAS DEL TORO: epiphyte, hills behind Fish Creek, vicinity of Chiriquí Lagoon, April 16, *von Wedel 2236* (Gray Herb., TYPE).

In its imbricate scape-bracts, broad leaf-blades and small flowers, *Catopsis micrantha* appears most closely related to *C. Morreniana*. However, its staminate flowers are much smaller, its inflorescence more branched, and its leaves broader and without the conspicuous white margin of *C. Morreniana*.

CATOPSIS NITIDA (Hook.) Griseb.—CHIRIQUÍ: forest, Bajo Mono, Boquete District, alt. 1350 m., April 9, 1938, *Davidson 535* (Herb. Field Mus.); Boquete, Boquete District, alt. 1140 m., July 1, 1938, *Davidson 863*. Previously known from the Greater Antilles, Guiana, Guatemala, Honduras and Costa Rica.

GUZMANIA CORIOSTACHYA (Griseb.) Mez.—COCLÉ: hills north of El Valle, Jan. 13, 1942, *Allen 2945*. Previously known from Costa Rica, Colombia, and Venezuela.

GUZMANIA DONNELLSMITHII Mez ex Donn. Smith in Bot. Gaz. **35**:9. 1903. (*Thecophyllum angustum* Mez & Wercklé in Bull. Herb. Boiss. II, 4:1121. 1904).

GUZMANIA NICARAGUENSIS Mez & C. F. Baker.—COCLÉ: north of El Valle de Antón, near La Mesa, alt. ca. 1000 m., Nov. 12, 1941, *Allen 2803* (Gray Herb.). Previously known from Guatemala, Nicaragua and Costa Rica.

PITCAIRNIA APHELANDRAEFLORA Lem.—BOCAS DEL TORO: on rock, hills behind Fish Creek, vicinity of Chiriquí Lagoon, April 22, 1941, *von Wedel 2282* (Gray Herb.). Previously known from Amazonian Brazil and Peru.

The Panamanian material has two narrow auricles at the base of the petal but is otherwise typical.

THECOPHYLLUM PEDICELLATUM Mez & Wercklé. — CHIRIQUÍ: rain forest, Bajo Chorro, Boquete District, alt. 1800 m., Feb. 17, 1938, *Davidson 307* (Herb. Field Mus.). Previously known from Costa Rica.

The Panamanian specimen has much larger leaves, branches and floral bracts than is usual, but it is too old to show whether these are supported by other characters which would distinguish it specifically.

TILLANDSIA ADPRESSA André var. TONDUZIANA (Mez) L. B. Smith.—CHIRIQUÍ: rain forest, Bajo Chorro, Boquete District, alt. 1800 m., Feb. 13, 1938, *Davidson 280*. Previously known from Costa Rica.

TILLANDSIA FASCICULATA Sw. var. CONVEXISPICA Mez.—CANAL ZONE: Barro

Colorado Island, Aug. 1928, *Chickering 63* (Herb. Univ. Michigan). Previously known from Jamaica, Mexico, British Honduras and Guatemala.

TILLANDSIA FASCICULATA Sw. var. UNCISPICA Mez.—BOCAS DEL TORO: Isla Colón, May 16, 1940, *von Wedel 118;* Water Valley, vicinity of Chiriquí Lagoon, Oct. 26, 1940, *von Wedel 1377;* same, Oct. 28, 1940, *von Wedel 1396;* Little Bocas, vicinity of Chiriquí Lagoon, July 13, 1941, *von Wedel 2528.* Previously known from Cuba, Santo Domingo, Saint Lucia and Guatemala.

TILLANDSIA GUANACASTENSIS Standley. — COCLÉ: vicinity of El Valle de Antón, alt. ca. 600 m., Dec. 10, 1939, *Allen 2060.* Previously known from Costa Rica.

TILLANDSIA SINGULARIS Mez & Wercklé.—COCLÉ: region north of El Valle de Antón, alt. ca. 1000 m., Jan. 13, 1942, *Allen 2898* (Gray Herb). Previously known from Costa Rica.

MORACEAE

(P. C. Standley)

CLARISIA **mollis** Standl., sp. nov.—Arbor 10-metralis, ramulis sat gracilibus sordido-ochraceis sparse pilosulis, internodiis elongatis; folia majuscula 1.5 cm. longe petiolata crasse membranacea; lamina obovato-oblonga ca. 25 cm. longa et 9–10.5 cm. lata, apice rotundata et abrupte caudato-acuminata, acumine obtuso fere 2 cm. longo, basi cuneato-acuta, remote inconspicue serrato-dentata, supra glabra, venis obscuris, subtus fere concolor ubique sed praesertim ad nervos venasque breviter molliterque sordido-pilosula, costa tenui prominente, nervis lateralibus utroque latere ca. 13 tenuibus angulo acuto adscendentibus prope marginem arcuato-conjunctis, venis prominulis laxe reticulatis; spicae masculae in axillis binae sessiles interdum bifidae usque 4.5 cm. longae dense multiflorae, bracteis parvis peltatis minute pilosulis.—BOCAS DEL TORO: vicinity of Chiriquí Lagoon, Oct. 8, 1940, *H. von Wedel 1090* (Herb. Field Mus., TYPE; duplicate in Herb. Missouri Bot. Gard.)

Eight species of this genus are known, all except *C. mexicana* (Liebm.) Lanjouw in South America. *C. mollis* is related, apparently, to *C. mattogrossensis* Lanjouw, but is clearly distinct in its pubescence and leaf details. The available material, unfortunately, is incomplete and does not permit a satisfactory diagnosis of the species.

NYCTAGINACEAE

(P. C. Standley)

NEEA **pycnantha** Standl., sp. nov.—Frutex 4.5 m. altus, ramulis crassiusculis glabris; folia modica membranacea opposita ca. 2 cm. longe petiolata; lamina elliptico-oblonga vel ovato-oblonga paullo infra medium latissima 11.5–18.5 cm. longa 5–8 cm. lata longiuscule acuminata, basi acuta, glabra, supra lucida, nervis venisque non elevatis, subtus concolor, costa gracili elevata, nervis lateralibus

utroque latere ca. 12 angulo latiusculo adscendentibus gracillimis prominentibus; inflorescentia ut videtur deflexa cymoso-corymbosa 9.5 cm. longe pedunculata, pedunculo gracillimo glabro, ca. 6.5 cm. longa et aequilata laxe multiflora, ramis minutissime ferrugineo-puberulis; bracteae conspicuae patentes lineari-subulatae 2.5–3.5 mm. longae attenuatae minute puberulae, floribus sessilibus aggregatis; perianthium albescens tubulosum 7–9 mm. longum 2.5 mm. latum glabrum fauce paullo angustatum basi obtusum, dentibus late deltoideo-ovatis vix ultra 8 mm. longis.—BOCAS DEL TORO: Water Valley, region of Chiriquí Lagoon, Nov. 9, 1940, *H. von Wedel 1574* (Herb. Field Mus., TYPE; duplicate in Herb. Missouri Bot. Gard.).

The species has better characters than most members of this genus, and is noteworthy for the very numerous, small but conspicuous, slender, spreading bracts of the inflorescence.

NEEA **xanthina** Standl., sp. nov.—Arbor 9-metralis praeter inflorescentiam fere omnino glabra, ramis crassiusculis ochraceis, novellis minute adpresse ferrugineo-tomentulosis; folia parva opposita firme membranacea glabra, petiolo 5–7 mm. longo; lamina oblongo-elliptica prope medium latissima 5.5–8 cm. longa 2–3.2 cm. lata abrupte breviter acuminata, acumine obtuso, basi late acuta, supra sublucida, costa nervisque non elevatis, subtus concolor, costa tenui prominente, nervis lateralibus utroque latere ca. 8 tenerrimis angulo latiusculo adscendentibus arcuatis, venis inconspicuis laxe reticulatis; inflorescentia parva laxe multiflora ut videtur erecta 3 cm. longe pedunculata, 2.5 cm. longa 3–5 cm. lata, bracteis minutis linearis-subulatis, ramis minute sparseque ferrugineo-puberulis; flores flavescentes graciliter pedicellati, pedicellis rubris 2–4 mm. longis; perianthium ellipsoideum 5 mm. longum 2–2.5 mm. latum sparse minutissime puberulum vel fere glabrum, apice contractum, dentibus late deltoideis minutis, basi acutiusculum.—BOCAS DEL TORO: Old Bank Island, vicinity of Chiriquí Lagoon, Feb. 4, 1941, *H. von Wedel 1970* (Herb. Field Mus., TYPE; duplicate in Herb. Missouri Bot. Gard.).

An inconspicuous plant, without any outstanding specific characters, but unusual among Panama species of *Neea* because of the very small leaves and small flowers.

ANNONACEAE

XYLOPIA **bocatorena** Schery, n. sp. — Arbor, ramis juventute dense brevissimeque pubescentibus pilis brunneo-flavis demum glabris brunneis lenticellis prominentibus; foliis distichis alternatis elliptico-lanceolatis apice attenuatissimis basi acutis 8–11 cm. longis 2.3–3.5 cm. latis, petiolis 2–3 mm. longis supra sulcatis glabrisque subtus rotundatis pubescentibusque; laminis supra glabris costa aliquid immersa subtus aliquid pubescentibus pilis adpressis, nervis lateralibus reticulatis confluentibus; floribus ovoideis axillaribus solitariis, pedicellis 5–6 mm. longis bracteis 2 emarginatis vel bilobatis; calyce cupuliformi 6–8 mm. diametro extus pubescente intus glabro, lobis 3 deltoideo-ovatis; petalis exterioribus valvatis ovato-lanceolatis extus pubescentibus intus brevi-pubescentibus ca. 12 mm. longis

ca. 6 mm. latis, petalis interioribus valvatis cum exterioribus alternantibus ca. 11 mm. longis 4–5 mm. latis; staminibus numerosis linearibus 3 mm. longis, antheris 1 mm. latis, carpellis linearibus ca. 8 centro calycis affixis 2–3 mm. longis apice brevi-subhirsutis basi pubescentibus; fructibus 1–4 ex pedicello rubris obovoideo-clavatis dehiscentibus ca. 2 cm. longis, seminibus 2 nigris.—BOCAS DEL TORO: Isla Colón, Nov. 16, 1941, *H. von Wedel 2965* (Herb. Missouri Bot. Gard., TYPE).

This species resembles the descriptions of *X. brasiliensis* Spreng. and *X. amazonica* Fries. It differs from the former, to which it keys in Fries' revision of *Xylopia* (Acta Hort. Berg. **10**:86-214. 1931), in having wider leaves more rounded at the base, and a distinctly cupuliform calyx. From *X. amazonica* it differs in having less pubescent leaves, larger flowers, etc. The flowers are solitary on short pedicels, the pedicels bearing a larger emarginate or cleft upper bract and a similar smaller lower bract oriented at about 120° angle from the upper one. The separate carpels each bear terminally a lightly white-hirsute style. At full maturity of the flower the carpels are golden-brown at the base. The fruit is red, obovoid or subclavate, slightly constricted between the 2 seeds, and with a barrowed basal stipe 2–5 mm. long. The pericarp splits down one side, exposing the black seeds.

CYMBOPETALUM **magnifructum** Schery, n. sp.—Arbor 12 m. alta, ramis juventute dense pubescentibus demum glabris in sicco rugosis griseis; foliis alternatis, petiolis 2–3 mm. longis pubescentibus supra planis; laminis parvis (juventute (?) 3–4 cm. longis) ovatis apice basique acutis in petiolo decurrentibus leviter pubescentibus vel glabris; floribus solitariis, pedicellis pubescentibus angulatis ebracteatis 2.5–3.0 cm. longis, sepalis 3 ovato-triangularibus, majoribus 4–5 mm. longis leviter pubescentibus, petalis interioribus 3 obovatis majoribus levitissime pubescentibus ca. 17 mm. longis 12 mm. latis apice truncato-inflexis basi incrassatis; staminibus multis linearibus apice truncatis 2.5 mm. longis longitudinaliter bilocularibus, carpellis ca. 14 linearibus apice dense pubescentibus truncatis ca. 2.5 mm. longis, toro rotundato-convexo; fructu magno obovoideo glabro lepidoto nigro 6 cm. longo 4 cm. lato, pericarpio crasso dure-coriaceo; seminibus 6 semilunatis 2.5 cm. longis.—PANAMÁ: vicinity of Bejuco, alt. ca. 50 m., May 6, 1941, *P. H. Allen 2455* (Herb. Missouri Bot. Gard., TYPE).

The Allen specimen is so distinct from previously known species of *Cymbopetalum* that placing it to the genus was rather difficult. However, Dr. P. C. Standley agrees that this plant could scarcely be placed elsewhere than in *Cymbopetalum*. The plant is characterized by the moderately short pedicels, distinctive flowers, and extremely large, obovoid fruit. It appears doubtful that the small leaves of the type specimen have reached mature size, since they are found only on the young lateral branches. The fruit has a very thick (1.5–3.0 mm.) leathery pericarp, black and minutely lepidote on the outside. The 6–7 large seeds are closely packed and are covered with a fleshy matrix which when dry has the color and odor of prunes.

SAXIFRAGACEAE

PHYLLONOMA RUSCIFOLIA Willd.—CHIRIQUÍ: Cerro Horqueta, cloud forest, April 26, 1940, *C. von Hagen & W. von Hagen 2043*. Described by the collectors as "Tree 20′; fruit white, odorless, attached to rib of leaf."

The peculiar genus *Phyllonoma*, characterized superficially by the adnation of a cluster of minute flowers high on the leaf blade, has been reported from Mexico, Guatemala, Costa Rica, Colombia, and Peru. A general discussion of the speciation, but unfortunately not a very clear one, is given by Pittier (Contr. U. S. Nat. Herb. **12**:172-174. 1909). From this account, incidental to the description of two new species from Costa Rica, and from the relatively few herbarium specimens available for the entire genus, we suspect that the variability of the genus is not yet satisfactorily understood, and are identifying our specimen, provisionally, with the earliest binomial (as illustrated by Kunth under *Dulongia acuminata* in HBK. Nov. Gen. & Sp. **7**: *pl. 623*. 1825). Our material is rather copious, and upon its branches one may find some leaves which are essentially entire and others with 1, 2, or 3 acuminate teeth. The flowers, also, vary in their arrangement, some with pedicels springing directly from the leaf and others borne upon short racemose peduncles.

LEGUMINOSAE

MACROLOBIUM **modicopetalum** Schery, n. sp.—Arbor, ramis novellis subglabris vetustioribus glabris; foliis 1-jugatis glabris, petiolis brevibus (3–10 mm. longis) teretibus profunde canaliculatis; laminis coriaceis sessilibus vel petiolulis ad 3 mm. longis ellipticis basi inaequaliter subacutis apice breviter attenuatis et obtuse mucronatis 12–23 cm. longis 4–9 cm. latis, nervis supra subplanis subtus prominentibus, nervis lateralibus perspicue confluentibus; inflorescentiis spicatis glabris vel brevissime pubescentibus plerumque ex ramis vetustioribus, alabastris obovoideis ca. 5 mm. longis; floribus ca. 16 anguste pedicellatis basi bracteo subpersistente obovato vaginato bilobato 7–9 mm. longo lobis ca. 4 mm. latis, sepalis 4 oblongis apice obtusis glabris imbricatis 6–7 mm. longis 2.5–4.0 mm. latis, petalo 1 albo ovato-lanceolato concavo margine perspicue undulato-inhorrescente 12–13 mm. longo 6–8 mm. lato brevissime unguiculato; staminibus 3, sepalis ventralibus oppositis, filamentis glabris linearibus 11–19 mm. longis, antheris ovatis bilocularibus versatilibus ca. 3 mm. longis 2 mm. latis; ovario compresso ovato-lunato ca. 3 mm. longo ad margines pubescente ad confluentem sepalorum substipitato, ovulis 4 ovatis ca. 0.7 mm. longis; stylo glabro cum ovario 16–20 mm. longo, stigmate terminali certe capitato pubescente.—BOCAS DEL TORO: Fish Creek, Apr. 15, 1941, *H. von Wedel 2226* (Herb. Missouri Bot. Gard., TYPE); same locality, Apr. 9, 1941, *H. von Wedel 2209;* Apr. 22, 1941, *H. von Wedel 2291;* May 7, 1941, *H. von Wedel 2399* (Herb. Missouri Bot. Gard., COTYPES).

Macrolobium modicopetalum falls into the section VOUAPA of the genus. It resembles several of the unijugate species such as M. *floridum* Karst., M. *ischno-*

calyx Harms, *Vouapa Pittieri* Rose (ex char.), etc. In Martius (Fl. Bras. 15²:219. 1870) it keys near M. *punctatum* Spruce, and judging from available descriptions alone it apparently differs from newer Brazilian species. This is to be expected, as Britton and Killip (N. Y. Acad. Sci. 35:166. 1936) include only one species from Colombia *(M. floridum)* in their genus *Macrolobium*, within which M. *modicopetalum* obviously belongs. *M. modicopetalum* differs from *M. floridum* in having 4 rather than 5 ovules, glabrous rather than pilose bracts and styles, attenuate rather than acute leaf blades, inflorescences generally on older wood rather than terminal, etc. *M. modicopetalum* differs from *Vouapa Pittieri* (the only species listed from North America by Britton and Rose, N. Am. Fl. 23:226. 1930) in having smaller leaves and the petal 1.3 cm. rather than 4.0 cm. long.

Were not M. *modicopetalum* from a region where this preponderantly Brazilian genus is very rare, one would hesitate to describe it without first seeing authentic material of related species, for it is often difficult, as well as tedious, to distinguish these species by description alone. However, *M. modicopetalum* is clearly different from all Colombian, Venezuelan and other North American species known to me.

The following characters are helpful in distinguishing this species: (1) moderately large, unijugate, glabrous leaves, (2) inflorescences usually not terminal, (3) conspicuous, glabrous pedicellar bract, cleft about half its length, (4) moderate-sized, scarcely-clawed petal, (5) glabrous style, filaments, petal and sepals, (6), 4-ovulate ovary.

LONCHOCARPUS **monofoliaris** Schery, n. sp.—Arbor ramis teretibus glabris; foliis alternatis unifoliatis, stipulis non visis, petiolis (rhachide incluso) 8–9 mm. longis subglabris basi plus minusve teretibus apice supra profunde canaliculatis, petiolulis subglabris 2–3 mm. longis supra canaliculatis; laminis glabris elliptico-lanceolatis basi acutis vel obtusis apice obtuse brevi-mucronatis, supra plani-nervatis subtus costa prominente nervis lateralibus ca. 12 arcuatis; inflorescentiis axillaribus spicato-paniculatis 5–12 cm. longis, pedunculis primariis leviter subpubescentibus, pedunculis secondariis subpubescentibus 1–2 mm. longis apice plerumque pedicellos binos pubescentes 1–2 mm. longos minute 2-bracteolatos gerentibus, bracteis parvis 0.5–1.0 mm. longis, lanceolatis; calyce turbinato cupuliformi breviter 5-dentato pubescente ca. 1.5 mm. alto 3–4 mm. lato; vexillo orbiculari-subauriculato extus pubescente apice retuso basi subauriculato, ungue ca. 1.5 mm. longo, alis ungue ca. 3 mm. longo, limbo elliptico ca. 7 mm. longo ca. 3 mm. lato, carinis ungue ca. 3 mm. longo, limbo obovato-elliptico 6–7 mm. longo ca. 2.5 mm. lato; filamentis omnibus coalitis, columna glabra cylindrica basi 2-fenestrata, fenestrae marginibus lateralibus callosis; antheris bilocularibus lanceolatis versatilibus; ovario lineari compresso 3-ovulato pubescenti marginibus inferioribus superioribusque aequicrassis; stylo brevi-pubescente; stigmate terminali parvo glabro.—BOCAS DEL TORO: Water Valley, Sept. 11, 1940, *H. von Wedel*

699 (Herb. Missouri Bot. Gard., TYPE); same locality, Sept. 23, 1940, *H. von Wedel 910* (Herb. Missouri Bot. Gard., COTYPE).

This species is especially distinguished by its unifoliolate leaves, a character shared to the best of my knowledge by only two other species in the genus and by only four or five genera in the Dalbergieae. Although no fruit is here available for definite generic location of this material, it could scarcely fall elsewhere than in *Lonchocarpus*. It possesses all the characters listed for that genus by Pittier (Contr. U. S. Nat. Herb. **20**:38. 1917), and also compares well with various floral illustrations of *Lonchocarpus*. In Pittier's subdivision of the genus, *L. monofoliolaris* keys to subgenus EULONCHOCARPUS, series PLANINERVI, section EPUNCTATI. The species it comes near is the Mexican *L. unifoliolatus* Benth., from the description of which it differs by having shorter petiolules, an orbicular-subauriculate rather than ovate standard, a cylindric rather than a broadly dilated staminal tube, blue or purple rather than pink flowers, etc.

The flowers are borne in gracefully curved spike-like panicles, the panicles occurring singly in the axils of the leaves. The short pedicels are attached to the expanded apex of the peduncles, a pair to each peduncle. At the base of the calyx two small ovate bracts are borne laterally. The calyx is shallow and very briefly 5-dentate, the 2 upper dentations being approximate. The standard is retuse apically, pubescent on the back, and bears a thick crescent-shaped ridge at the base running from "auricle" to "auricle" just above the juncture with the claw. The keel petals are joined on their lower margin and are closely invested by the wings to which they seem to adhere but are not organically attached. The androecium consists of ten more or less alternating long and short stamens, the filaments of which are united into a monadelphous tube. At the base of the tube are two fenestrae, one on either side of the vexillar filament, each of which has a thick callous at its lateral margin. The vexillar filament appears to be very insecurely attached to the receptacle. The laterally compressed ovary is only 3-ovulate, the ovules being attached to the thick upper margin. The structure of the ovary suggests that the fruit has wide margins at the juncture of the valves, but is not especially thickened at the point of attachment of the seeds.

ORMOSIA **stipitata** Schery, n. sp. (fig. 2).—Arbor ca. 15 m. alta, ramis glabris vel juventute leviter aureo-pubescentibus brunneis subangulatis in sicco longitudinaliter rugosis, lenticellis albis ovalibus prominentibus; foliis suboppositis 5–9-foliolatis, petiolis crassis in sicco irregulariter rugosis supra planis pubescentibus subtus teretibus subglabris cum rhachidibus 11–17 cm. longis, petiolulis teretibus nigris crassis pubescentibus 6–8 mm. longis, foliolis suboppositis; laminis ellipticis vel elliptico-lanceolatis basi acutis vel obtusis apice acutis breviter obtuseque attenuatis supra plus minusve glabris, nervis planis subtus aureo-pubescentibus pallidis, costa prominente nervis lateralibus subprominentibus plerumque 12–16; inflorescentiis spicatis angulatis arcuatis aureo-pubescentibus 10–18 cm. longis terminalibus et ex folium apicalium axillibus, bracteis minutis lanceolatis ca. 1

mm. longis, pedicellis erectis 5–6 mm. longis apice subrevolutis et aliquid clavatis, alabastris levitissime imbricatis 4–5 mm. latis; calyce dense pubescente ca. 1 cm. in diametro basi tubo substipitato apice, lobis triangularibus subaequalibus ca. 4 mm. latis; vexillo obcordato profunde retuso (vagina ca. 3.5 mm. longa) glabro ca. 15 mm. longo et lato ungue crasso ca. 5 mm. longo, alis glabris oblongo-lunatis lamina ca. 11 mm. longa ungue ca. 3 mm. longo, carinis oblongis glabris (margine inferiore breviter brunneo-pubescente) lamina ca. 13 mm. longa ungue ca. 3 mm. longo; staminibus 10 liberis cum brevibus et longis alternantibus, filamentis glabris lanceolato-linearibus 9–15 mm. longis basi 1.0–1.5 mm. latis calycis tubo affixis, antheris versatilibus breviter oblongis bilocularibus 1.0–1.5 mm. longis; ovario ovato lateraliter aliquid compresso dense pubescente ca. 6 mm. longo 4-ovulato

Fig. 2. *Ormosia stipitata* Schery

stipitato (stipite 4 mm. longo basi calycis tubo inaequaliter adnato) supra subtusque marginibus latis; stylo glabro apice inflexo, stigmate sublaterali bilobato.—CHIRIQUÍ: between Remédios and David, March 16, 1940, *Peggy White 306* (Herb. Missouri Bot. Gard., TYPE).

The type of *Ormosia stipitata* is reported as growing in open sunlight beside a river and as having a trunk 3–5 dm. in diameter. The young branches are quite stout and conspicuously longitudinally ridged in the dried state; they broaden laterally to the origin of petiole and peduncle. The terminal leaves are 5-foliolate, the subterminal ones up to 9-foliolate, which suggests that leaves of the older or lower branches are at least 9-foliolate. The dry leaflets are dull olive above and pallid below, with appressed golden pubescence on the lower surface. The whole branch tip forms a leafy "inflorescence", a few peduncles arising terminally and others singly from the axils of the upper leaves. Each is gracefully arcuate upward. The bracts subtending the pedicels are minute and scale-like.

The standard is lavender while the other petals are white. In the type specimen the topmost flowers of the peduncles are in bud, while immediately below this are found flowers with expanded petals, and on the basal half of the peduncle flowers from which the petals have fallen. In these lower flowers the stipitate ovary with the persistent style greatly protrudes from the calyx.

The filaments are entirely free and are attached in a circle to the upper part of the narrowed stipe-like calyx base, with the vexillar filament similar to the others. Wider and longer stamens alternate with shorter and narrower ones, although not all of either cycle are equally long. The basal part of the ovary stipe is briefly adnate above to the base of the calyx tube. The style is inflexed apically and in age is almost coiled. The young stigma is borne laterally at the very tip of the style and consists of 2 semi-circular knob-like parts.

Placement of this species to the proper genus is not an easy matter. Certainly in Bentham's time it could scarcely have fallen elsewhere than in *Ormosia* as the tribe SOPHOREAE was known by him. But in more recent treatments of the tribe (e. g. Taubert, Nat. Pflanzenfam. 3^3:186-199. 1891) this species would not key to *Ormosia* because of its long-stipitate ovary; rather it would seem to fall near *Alexa*, *Dussia*, *Bowdichia*, or one of several monotypic genera not native to the Americas. However, the White plant differs from the description of *Alexa* in lacking a sinuate-dentate calyx, linear anthers, many ovules, and unpaired leaflets; from *Dussia* in lacking 9 coalesced (at base) filaments, large inflorescence bracts, terete (?) fruit, and unpaired leaflets; from *Bowdichia* in lacking many ovules, many leaflets, and linear weakly winged fruit (?). Neither is it *Vexillifera* (synonym of *Dussia* fide Harms), nor *Cashalia* (type species of this genus a synonym). Thus the White plant appears to differ more radically from other genera than from *Ormosia* and should be considered as belonging to this genus, especially in that several species of *Ormosia* have ovaries stipitate in various degrees.

Among species of *Ormosia*, *O. stipitata* appears to fall somewhat near *O. fastigiata* Tul. in the section BICOLORES. It keys near that species or closely related species in the treatments of both Bentham (Mart. Fl. Bras. 15^1:319. 1862) and of Ducke (Archiv. Jard. Bot. Rio de Janeiro 4:61-71. 1925). It seems to fit no adequately described species of *Ormosia* and certainly fits no described species of *Dussia*. Perhaps *Ormosia panamensis* Benth. from the Panama region may prove to be the same, but it differs in description from *O. stipitata* in having the leaflets pubescent above. The description of *O. panamensis* is taken by Seemann (Voyage of the Herald, p. 111. 1853) from Bentham's manuscript and is entirely inadequate for complete comparison, nor is there a specimen of this species in the herbarium of the Missouri Botanical Garden. Since *O. stipitata* is poorly represented by duplicate specimens it is here illustrated (fig. 2).

SWARTZIA **nuda** Schery, n. sp.—Arbor vel arbuscula fere omnino glabra, ramis teretibus; foliis alternatis, 5 (raro 3)-foliolatis (petiolis rhachidibus inclusis) 10-13 cm. longis supra planis 2–3-striolatis basi nigro-callosis, nodulis aliquid tumidis,

petiolulis 4–8 mm. longis teretibus nigro-callosis supra canaliculatis; laminis ellipticis 14–32 cm. longis 6–13 cm. latis basi acutis vel obtusis apice acutis breviter attenuatis, nervis supra planis, subtus costa et nervis lateralibus prominentibus leviter scarioso-pubescentibus, nervis lateralibus ca. 12–20 arcuatis confluentibus; inflorescentiis axillaribus (1–3 ex ramis vetustioribus) spicatis multifloris 5–16 cm. longis leviter brevi-pubescentibus, pedicellis 1.0–1.5 cm. longis, alabastris globularibus ca. 6 mm. diametro 3–5-lobatis, floribus apetalis; staminibus numerosis plus minusve 2-seriatis plerisque 1–1.5 cm. longis aliquot 1.9–2.1 cm. longis, filamentis filiformibus glabris, antheris oblongis bilocularibus suberectis, brevioribus 1.5–1.8 mm. longis, longioribus 2.0–2.5 mm. longis; ovario lineari stipitato 2–3 cm. (stylo incluso) longo, ovulis ca. 13 obovato-lunatis subterminaliter funiculatis; stylo arcuato 6–7 mm. longo, stigmate terminali truncato-capitato; fructu elongato 12–20 cm. longo subterete tarde dehiscente basi stipitato apice attenuato, loculis 1–2 elliptico-lunatis 1.3–2.0 cm. latis constrictionibus interlocularibus 0.2–1.0 cm. latis, seminibus 1–2-arillatis linearibus ca. 5 cm. longis 0.7 cm. latis.—BOCAS DEL TORO: Isla Colón, Oct. 18, 1940, *H. von Wedel 1224* (Herb. Missouri Bot. Gard., TYPE); same locality, Oct. 8, 1940, *H. von Wedel 1073;* Oct. 9, 1940, *H. von Wedel 1107;* Water Valley, Sept. 23, 1940, *H. von Wedel 909;* Sept. 24, 1940, *H. von Wedel 957;* Nov. 21, 1940, *H. von Wedel 1727* (Herb. Missouri Bot. Gard., COTYPES).

Swartzia nuda appears to fall in Bentham's section ORTHOSTYLEAE but does not closely resemble any known Panamanian species. In Britton and Rose's treatment of the genus (N. Am. Fl. 23^5:347. 1930), it keys to *Swartzia (Tounatea) caribaea* Griseb., from which species it differs markedly in size and shape of the leaflets and fruit. In Britton and Killip's work on Colombian Caesalpinaceae (Ann. N. Y. Acad. Sci. **35**. 1936), *S. nuda* does not fit any species in the key. Drs. Killip and Macbride, who have seen a fruiting specimen of *S. nuda,* feel certain that they have never encountered it in their South American work.

Swartzia nuda is especially distinctive in the following characters: (1) complete glabrescence of most parts, (2) very large leaflets with conspicuously confluent lateral veins, (3) spicate inflorescences from non-foliate nodes, (4) apetalous flowers, (5) long, slender, glabrous ovary and style, (6) very large, elongate, subterete fruit, which is often 2-locular with a marked constriction between the locules, (7) very long, slender, conspicuously arillate seeds.

MALPIGHIACEAE

BANISTERIOPSIS **scalariformis** Schery n. sp.—Planta arborescens (vel aliquid volubulis?), ramis glabris teretibus porphyreis in sicco longitudinaliter substriatis; foliis oppositis vel suboppositis, stipulis subinterpetiolaribus minutis deciduis, petiolis glabris ca. 5 mm. longis 1–1.5 mm. diametro supra canaliculatis; laminis glabris coriaceis ovatis vel ellipticis basi obtuse rotundatis biglandulosisque apice acuminatissimis in sicco supra porphyreis subtus brunneis, costa supra impressa subtus prominente, nervis lateralibus secondariis subparallelis scalariformibus ad

costam perpendicularibus; inflorescentiis terminalibus vel axillaribus leviter pubescentibus, bracteis primariis lanceolatis ca. 6 mm. longis bracteis secondariis minutis lanceolatis vel trilobatis; floribus ultimis plerumque 4-umbellatis, pedicellis gracilibus ca. 1 cm. longis; calyce glabro 8-glanduloso 5-lobato, lobis ovatis lobo maximo 3 mm. alto et lato, glandibus 1–2 mm. longis; petalis glabris, unguibus linearibus 2–3 mm. longis, limbis cupuliformibus margine fimbriatis petalis maximis ca. 5 mm. longis, petalis minimis ca. 3 mm. longis, floris minimi limbo basi biglanduloso; staminibus 10 glabris 2–4 mm. longis minoribus juxta petalo minimo, filamentis liberis linearibus basi confluentibus, antheris obovato-oblanceolatis bilocularibus connectivo crassissimo; stylo glabro lineari brunneo ca. 3 mm. longo apice stigmate subcapitato luteo; carpellis 3 subglabris triangularibus uniovulatis basi confluentibus.—BOCAS DEL TORO: Western River, Sept. 27, 1941, *H. von Wedel 2776* (Herb. Missouri Bot. Gard., TYPE); same locality and date, *H. von Wedel 2791* (Herb. Missouri Bot. Gard., COTYPE); Fish Creek lowlands, May 3, 1941, *H. von Wedel 2378* (Herb. Missouri Bot. Gard., COTYPE).

It is with temerity that this species is described as *Banisteriopsis*. First, the generic bounds in the Malpighiaceae are very confused, and various authors have persistently considered different genera as valid. Second, although this material was kept on hand for almost a year in the hope that material in fruit would turn up, no such specimens have yet become available. This is unfortunate, since in this family division into genera is based largely upon fruit characters. However, comparison of the Wedel specimens with all Malpighiaceous plants in the Missouri Botanical Garden herbarium showed no match; neither could the specimens be keyed-out in Small's monograph (N. Am. Fl. **25**. 1910) nor in Niedenzu's monograph (Pflanzenreich **IV**. 141. 1928) of the Malpighiaceae. Nor could the plant be satisfactorily located in Standley's 'Flora of Costa Rica', Standley's 'Flora of the Canal Zone', nor in Martius' 'Flora Brasiliensis.' Apparently the species has never been described, but future monographic work or future collections may necessitate its transfer to another genus. In Small's monograph the Wedel specimens key to *Banisteriopsis lucida,* from which they differ especially in lacking such large flowers and the ferrugineous pubescence of the lower leaf surface. In Niedenzu's monograph the specimens key to the Brazilian *Banisteria schizoptera*. Morton considers *Banisteria* of Niedenzu to be the same as *Banisteriopsis* of Robinson (Proc. Biol. Soc. Wash. **43**:159. 1930). In the herbarium the Wedel specimens resemble *Banisteriopsis inebrians* Morton from Colombia.

This species is distinguished from most Malpighiaceous plants by the subparallel scalariform appearance of the secondary lateral veins. The leaf blade in the dry state usually appears red-brown above and brown below. On either side of the costa on the lower surface of the blade, at the juncture of the petiole, is found a small ovate gland. A pair of glands is similarly found at the base of the blade of the primary inflorescence bracts. These bracts are generally entire, although sometimes with 3 or 4 large dentations apically. The ultimate flower clusters are umbellate with usually 4 flowers on slender pedicels. The flowers are

essentially glabrous throughout, and slightly zygomorphic, usually with 2 large petals, 2 slightly smaller ones, and 1 small petal bearing 2 glands at the base of its limb. Apparently the stamens are somewhat shorter on the side next the small petal. The connective of the anthers is very bulky, usually dwarfing the pollen chambers. The styles are linear and slightly expanded apically into a truncate-subcapitate stigma. The carpels are easily separable and bear what appears to be a primordial wing or ridge externally. In two collections the plant has been described as a tree with yellow flowers and in the other as a vine with purple flowers.

ICACINACEAE

LERETIA CORDATA Vell.—BOCAS DEL TORO: Fish Creek Hills, May 12, 1941, *H. von Wedel 2443*. Previously known from Brazil and British Guiana (?). The von Wedel specimen in question was first considered different enough from the description of *L. cordata* to warrant publication as a new species. It differs in having glabrous rather than red-brown pubescent (glabrous in age) stems, shorter (5–6 mm.) rather than longer (8–15 mm.) petioles, elliptic rather than ovate-lanceolate leaves, essentially glabrous rather than pubescent lower leaf surface, 4–6 rather than 6–8 main lateral veins, brown rather than golden inflorescences, pedicels usually shorter than in the description, and ovary entirely pubescent rather than with a disc-like glabrous base. No rudimentary styles are found as seems to be the general condition with the species. Also L. B. Smith was unable to find a completely satisfactory match for the plant at the Gray Herbarium where some of R. A. Howard's annotated specimens are on deposit.

Yet examination of published illustrations, herbarium specimens, and reference to Howard's monograph of the genus (Jour. Arn. Arb. **23**:58-60. 1942) show this monotypic genus (fide Howard) to be exceedingly variable. Variations do occur which apparently cover all the above-mentioned differences between the von Wedel specimen and Howard's description of the species. Thus the specimen evidently is *L. cordata* and should be considered as a new record for the genus north of South America.

BEGONIACEAE

(L. B. Smith & B. G. Schubert)

BEGONIA CONCHAEFOLIA Dietr. (*B. pumilio* Standl.)—COCLÉ: vicinity of El Valle de Anton, *Allen 2925*. Also known from Costa Rica.

BEGONIA PITTIERI C. DC.—COCLÉ: La Mesa, Aug. 31, 1941, *Allen 2722*. Previously known from Costa Rica.

MYRTACEAE

CALYPTRANTHES **tumidonodia** Schery, n. sp. — Arbuscula, ramis novellis teretibus nodis tumidis duplo latior ramorum internodiis; foliis oppositis magnis glabris breve-petiolatis, petiolis 5 mm. longis furfuraceis supra subcanaliculatis; laminis ellipticis 12–28 cm. longis 5–9 cm. latis apice longe acuminatis vel caudatis,

costa supra indentata subtus prominente, nervis lateralibus parallelis vel subarcuatis ad margines confluentibus; inflorescentiis plerumque 2 ex nodo terminali vel penultimato brunneo-pubescentibus cymosis 3–4 plo divisis; floribus subsessilibus apetalis albis, tubo turbinato-cupuliformi extus lepidoto 3 mm. lato 2 mm. alto, limbo calyptriformi circumscissili 1 mm. alto; staminibus multis ad marginem tubi affixis, filamentis linearibus 5 mm. longis, antheris versatilibus bilocularibus 0.2 mm. latis; stylo lineari 4–5 mm. longo; ovario inferiori plerumque triloculari, loculo basi uniovulato.—BOCAS DEL TORO: Fish Creek Hills, Apr. 9, 1941, *H. von Wedel 2195* (Herb. Missouri Bot. Gard., TYPE); same locality, Apr. 14, 1941, *H. von Wedel 2223* (Herb. Missouri Bot. Gard., COTYPE).

This species is distinctive in a poorly-known genus by virtue of its large leaves, swollen nodes, and inflorescence and floral characters. The inflorescence is cymose and regularly 3–4 times divided so that the peduncle divides into 3 secondary peduncles, each of which divides into 3 tertiary peduncles, and these in turn bear either 3 quarternary peduncles or 3 short-petiolate flowers. The inflorescence much resembles that found in certain species of *Psychotria*. Apparently 2 inflorescences are usually borne together from the terminal node, although sometimes a single inflorescence arises from the terminal or penultimate node. The flower is apetalous and consists of a turbinate-cupuliform base or tube and a circumscissile calyptriform limb or cap which is shed before the stamens unfold. The stamens are attached to the margin of the tube and are infolded in bud in such a manner that the upper half of the filament is pressed against and parallel to the style, the anther resting near the style base. The many filaments may be partially adnate towards the base. The style is linear and somewhat coiled in bud. The ovary is usually indistinctly 3-locular, although occasionally 4-locular. Each locule contains a single ovule borne basally.

RUBIACEAE
(P. C. Standley)

HOFFMANNIA AERUGINOSA Standl.—BOCAS DEL TORO: Fish Creek Hills, April 22, 1941, *H. von Wedel 2289*. Described from Costa Rica.

MORINDA CITRIFOLIA L.—BOCAS DEL TORO: Isla Colón, Nov. 14, 1941, *H. von Wedel 2942*. Apparently the first record from continental North America. Previously known from Asia, Australia and the Pacific islands.

PSYCHOTRIA SOLITUDINUM Standl.—BOCAS DEL TORO: Fish Creek Hills, April 24, 1941, *H. von Wedel 2323*. Described from Costa Rica.

FLORA OF PANAMA

BY

ROBERT E. WOODSON, Jr.

AND

ROBERT W. SCHERY

AND COLLABORATORS

PART II

Fascicle 1

CYCADACEAE
TAXACEAE
TYPHACEAE
ALISMACEAE
BUTOMACEAE
TRIURIDACEAE
GRAMINEAE (Swallen)

ANNALS
OF THE
MISSOURI BOTANICAL GARDEN

Vol. XXX APRIL, 1943 No. 2

FLORA OF PANAMA

PART II

CYCADACEAE

Undershrubs or small trees of palm-like or fern-like habit. Stems underground to 10 m. or more in height, simple or rarely branched, disproportionately thick and fleshy, very rough with the persistent bases of fallen leaves. Leaves borne in a dense cluster at the crown of the stem, pinnately compound and usually massive. Staminate and ovulate strobili produced apically, both more or less woody and cone-like (except the ovulate in *Cycas*, which resembles a cluster of furry miniature leaves with marginal ovules toward the base); the microsporangia numerous, inferior; the ovules naked, usually paired, pendulous, somewhat drupe-like in fruit.

1. ZAMIA L.

ZAMIA L. Sp. Pl. 1659. 1753; Schuster in Engl. & Diels, Pflanzenreich 4^1:132. 1932.

Palma-Filix Adans. Fam. Pl. 2:21. 1763.
Aulacophyllum Regel, Gartenfl. 25:140. 1876.
Palmifolium O. Ktze. Rev. Gen. 2:803. 1891.

Fig. 1. *Zamia Skinneri*

Low stout undershrubs. Stems thick, cylindrical, wholly underground to nearly 1 m. tall. Leaves pinnate, the pinnae thickly coriaceous, many-nerved, articulated to the rachis. Both staminate and ovulate strobili cone-like, the sporophylls peltate, woody, truncate-pyramidal, hexagonal or subquadrate.

1. ZAMIA SKINNERI Warscz. in Otto & Dietr. Allg. Gartenz. 19:146. 1851; Schuster, loc. cit. 141. 1932.

Zamia pseudoparasitica Yates, in Seem. Bot. Voy. Herald 2:202. 1854; Schuster, loc. cit. 142. 1932.
Zamia chigua Seem. loc. cit. 201. *pl. 43.* 1854; Schuster, loc. cit. 141. 1932.
Zamia Lindleyana Warscz. in Wendl. Ind. Palm. 53. 1854.
Zamia Roezlii Regel in Linden, Cat. 10. 1873.

Issued June 15, 1943.

Aulacophyllum Skinneri (Warscz.) Regel, Gartenfl. 143. 1876.
Aulacophyllum Roezli Regel, loc. cit. 141. 1876.
Aulacophyllum Ortgiesii Regel, loc. cit. 1876.

Leaves about 1 m. long, the rachis relatively stout, smooth, or aculeolate; pinnae 2–13, narrowly to broadly lanceolate, opposite or alternate, 10–60 cm. long, 1.5–9.0 cm. broad, narrowed abruptly and unequally toward the rachis, acuminate and usually obscurely spinulose-dentate toward the tip. Staminate strobili elongate-cylindrical, 4–15 cm. long, 1.0–2.5 cm. thick, the peduncle stout, 2–12 cm. long; ovulate strobili cylindrical, 5–12 cm. long, 3–4 cm. thick, ferruginous-tomentulose, the peduncle stout, 2–7 cm. long.

Guatemala to Peru; in Panama found in forests upon both coasts, ascending to 300 m. in Coclé. The plants are found separately or in dense colonies. Infrequent.

BOCAS DEL TORO: Laguna de Chiriquí, *Hart 179*. CANAL ZONE: Santa Rita Trail, *Cowell 165*; Río Pequení, *Woodson, Allen & Seibert 1586*. COCLÉ: El Valle de Antón, *Pring & Woodson s. n.* DARIÉN: Marraganti, *Williams 682*; Yaviza, *Clayton s. n.*

The root of *Z. Skinneri* is highly poisonous, and all parts of the plant exude an abundant gelatinous compound when cut or broken. The published species of *Zamia* are numerous, but are indefinite in outline and have been very unsatisfactorily treated by monographers, notably Schuster. It is impossible, therefore, to tell with certainty whether the genus is monotypic in Panama, as treated here, or whether other valid entities are involved.

The Oriental genus *Cycas* frequently is encountered in gardens.

TAXACEAE

1. PODOCARPUS L'Her.

PODOCARPUS L'Her. ex Pers. Syn. Pl. 2:580. 1807.
Nageia Gaertn. Fruct. & Sem. 191. 1788, in part.

Shrubs to tall trees. Leaves spiral (in Panama), laminate, coriaceous, mucronate. Strobili dioecious: the staminate terminal or in the axils of the upper leaves, solitary or clustered, cone-like, sporophylls spiral, each bearing 2 microsporangia; the ovulate a small bracted spike bearing 1–2 terminal, inverted, naked ovules. Fruit drupaceous, usually fairly large.

1. PODOCARPUS ALLENII Standl. in Woodson & Schery, Ann. Missouri Bot. Gard. 28:409. 1941.

Large trees attaining 35 m. or more in height, the trunk as much as 1.5 m. in diameter at the base, with reddish-brown rimose bark. Leaves spiral, not greatly crowded, oblong-lanceolate, acuminate, rather gradually attenuate at the base, heavily coriaceous, with a prominent midrib, the adult 3–4 cm. long, the juvenile much longer and less coriaceous, 12–14 cm. long.

Panama, in mountain forests.

BOCAS DEL TORO: exact locality lacking, *Cox s. n.* COCLÉ: El Valle de Antón, *Allen 2298*. PANAMÁ: Cerro Campana, *Allen 2424, Allen 2437*.

Doubtfully distinguished from *P. oleifolius* Don, which ranges from Costa Rica to Peru. Mr. Allen reports the popular name as *Quahau,* and states that the natives use the smaller branches in the building of houses.

TYPHACEAE

1. TYPHA L.

TYPHA L. Sp. Pl. 971. 1753.

Massive semiaquatic perennial herbs with extensive fleshy rhizomes. Leaves elongate, flat, equitant. Flowering stems elongate, terete; flowers monoecious, very numerous in two adjacent dense, cylindric spikes, the staminate above the pistillate, each usually subtended by a reduced, spathe-like leaf; perianth reduced to bristles or hairs; ovary stipitate, 1–2-celled.

1. TYPHA ANGUSTIFOLIA L. Sp. Pl. 971. 1753.

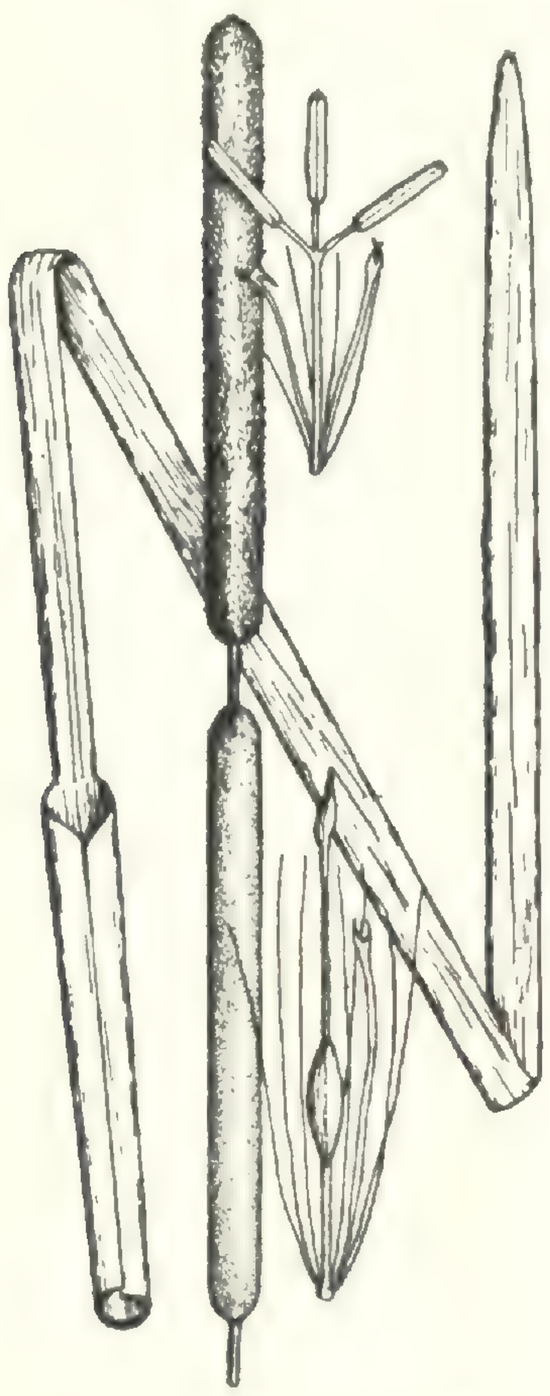

Fig. 2 *Typha angustifolia*

Plants 1–3 m. tall. Leaves narrowly ensiform, 0.3–1.0 cm. broad. Staminate and pistillate spikes of the inflorescence usually separated by a portion of naked peduncle, the pistillate less than 2 cm. in diameter; pistillate flowers usually having hair-like bractlets with dilated tips.

Very widely distributed in both hemispheres throughout the world, frequenting marshes and sloughs.

BOCAS DEL TORO: near Almirante, *Woodson & Schery s. n.* CANAL ZONE: Gatún Lake, *Killip 12186;* Frijoles, *Standley 31490;* Matachín to Las Cascadas, *Cowell 346.*

Graebner's account of Typhaceae (in Engl. Pflanzenreich 4^8:1-16. 1900) recognizes a most confusing array of species, subspecies, variety, lusus and proles segregation from which it appears unprofitable, if not impossible, to disentangle the complete bibliography of our Panama plant.

Typha angustifolia, the Narrowleaf Cat-tail of the United States, is known under the name of *Tule, Tule de Balsa, Enea,* and *Espadaña.* According to Standley (Fl. Costa Rica 1:66. 1937), the fluffy "wool" from the spikes is sometimes used for stuffing pillows and cushions.

The POTAMOGETONACEAE probably are represented in the streams and ponds of highland Panama, but have not as yet been collected. *Potamogeton foliosus* Raf. is reported from Costa Rica by Standley (Fl. Costa Rica 1:66. 1937). The plants are aquatics with usually narrow, submerged or floating leaves and small spikes of minute green flowers.

ALISMACEAE

Annual or perennial, acaulescent, aquatic or marsh herbs. Leaves basal, usually cordate or sagittate. Flowering scapes erect or floating, simple or branched. Flowers perfect or unisexual, whorled, regular, borne in terminal racemes or panicles. Sepals 3, separate, green, persistent. Petals 3, separate, deciduous, white or pink. Stamens 6 or more, the filaments separate. Carpels separate, few or numerous, 1-celled, containing 1 to several ovules; fruit a cluster of achenes.

a. Flowers all perfect ..... 1. ECHINODORUS
aa. Flowers polygamous, monoecious or dioecious, the lower perfect or pistillate, the upper staminate.
b. Lower flowers perfect ..... 2. LOPHOTOCARPUS
bb. Lower flowers pistillate ..... 3. SAGITTARIA

1. ECHINODORUS L. C. Rich.

ECHINODORUS L. C. Rich. Mém. Mus. Paris 1:365. 1815; Small, N. Am. Fl. 17[1]:45. 1909.

Helianthium Engelm. ex Britton, Man. 54. 1905; Small, loc. cit. 1909.

Annual or perennial, usually acaulescent, marsh herbs. Leaves erect or ascending, narrow or broad, cordate or attenuate at the base. Flowering scapes generally surpassing the leaves, simple or branched, bearing 1 to numerous whorls of flowers, the pedicels short or virtually lacking. Flowers all perfect; sepals 3, green; petals 3, white or pink; stamens few or numerous; carpels numerous; fruit an achene.

a. Plants very small, about 3–15 cm. tall; leaves linear to narrowly elliptic, not cordate; inflorescences simple, bearing 1–2 clusters of flowers ..... 1. E. TENELLUS
aa. Plants large, 1 m. tall or more; leaves broadly cordate; inflorescences usually branched at the base, bearing numerous clusters of flowers.
b. Flowers distinctly pedicellate, at least in fruit; inflorescences simple or sparingly branched at the base.
c. Sepals not accrescent, reflexed from the fruit-head; pedicels and petioles muricate ..... 2. E. MURICATUS
cc. Sepals accrescent and enveloping the fruit-head; pedicels and petioles not muricate ..... 3. E. LONGIPETALUS
bb. Flowers sessile or virtually so; inflorescences paniculately branched ..... 4. E. BRACTEATUS

1. ECHINODORUS TENELLUS (Mart.) Buch. Abh. Nat. Ver. Bremen 2:18. 1868.

Alisma tenellum Mart. ex R. & S. Syst. 7:1600. 1830.
Echinodorus parvulus Engelm. in Gray, Man. 438. 1856.
Helianthium tenellum (Mart.) Britton, Man. 54. 1905.
Helianthium parvulum (Engelm.) Small, N. Am. Fl. 17[1]:45. 1909.

Plants 3–15 cm. tall. Leaves linear to narrowly elliptic, 1–3 cm. long, gradually narrowed into the elongate petioles. Flowering scapes solitary or clustered, about as long as the leaves or longer. Flowers 2–8, the pedicels 0.05–0.2 cm. long, reflexed in fruit; sepals and petals orbicular, about 0.2 cm. long. Fruit-heads 0.3–0.4 cm. in diameter, enclosed by the persistent sepals; achenes 0.01–0.015 cm. long.

Northeastern United States to Brazil and Paraguay, in wet meadows and pond margins.

CHIRIQUÍ: El Boquete, *Killip 3618*. COCLÉ: Penonomé, *Williams 246*.

2. ECHINODORUS MURICATUS Griseb. Bonplandia 6:11. 1858.

Echinodorus macrophyllus β. muricatus (Griseb.) Micheli, in DC. Monogr. 3:50. 1881.

Fig. 3. *Echinodorus muricatus*

Plants stout, 1 m. tall or more. Leaves cordate, broadly ovate to subreniform, obtuse, 3–4 dm. long; petioles elongate, muricate. Flowering scape simple or sparingly branched at the base, bearing numerous sparse whorls of pedicellate flowers, strongly muricate; pedicels 1.5–2.5 cm. long, muricate; sepals broadly ovate to suborbicular, 0.5–0.6 cm. long; petals white, 1.0–1.5 cm. long.

Panama to the Guianas, in wet meadows and along pond and stream margins.

CHIRIQUÍ: Boquete, *Woodson & Schery 754; Davidson 691*. COCLÉ: between Las Margaritas and El Valle, *Woodson, Allen & Seibert 1736;* El Valle de Antón, *Seibert 490; Hunter & Allen 381*.

E. muricatus ordinarily is treated as a variety of *E. macrophyllus* (Kunth) Micheli. In Panama, however, the entity is so uniform in the muricate surface of the petioles and peduncles that it is the most easily recognized of the genus.

3. ECHINODORUS LONGIPETALUS Micheli, in DC. Monogr. 3:60. 1881.

Echinodorus punctatus Micheli, loc. cit. 59. 1881.
Echinodorus tunicatus Small, N. Am. Fl. 17^1:48. 1909.

Plants about 1 m. tall. Leaves ovate, deeply cordate, obtuse at the apex, 1–4 dm. long; petioles elongate. Flowering scape simple or branched sparingly at the base, bearing numerous rather distant whorls of flowers; pedicels 1.0–2.5 cm. long, reflexed in fruit; sepals ovate-reniform, 0.5 cm. long, accrescent and enveloping the fruit-head; petals 0.55–0.6 cm. long.

Panama to Brazil and Paraguay, in swamps and wet fields.

DARIÉN: Marraganti, *Williams 991*. PANAMÁ: Río Tecúmen, *Standley 29403;* Juan Díaz, *Standley 30506;* Matías Hernández, *Pittier 6894*.

4. ECHINODORUS BRACTEATUS Micheli, in DC. Monogr. 3:59. 1881.

Plants 1.5–2.0 m. tall. Leaves broadly ovate, broadly cordate, acute or shortly

acuminate at the apex, 25–35 cm. long; petioles elongate. Flowering scape paniculately branched, bearing numerous whorls of sessile or subsessile flowers; sepals broadly ovate, 0.4–0.5 cm. long, reflexed in fruit; petals 1.0–1.5 cm. long.

Panama, in moist fields and sloughs.

CANAL ZONE: Chagres, *Fendler 435;* Paraiso, *Pittier 2531.* COLÓN: Catival, *Standley 30444.* PANAMÁ: Río Tecúmen, *Standley 26724.*

2. LOPHOTOCARPUS T. Durand

LOPHOTOCARPUS T. Durand, Index Gen. Phan. 10. 1888; Small, N. Am. Fl. 17^1:48. 1909.

Lophiocarpus Miq. Fl. Arch. Ind. 1^2:50. 1870, non Turcz.

Annual or perennial aquatic herbs with floating, cordate leaves. Flowering scapes simple, bearing several whorls of flowers toward the tip, the lower perfect, the upper staminate. Sepals 3, green; petals 3, white; stamens 9–15; carpels numerous.

1. LOPHOTOCARPUS GUYANENSIS (HBK.) J. G. Smith, Rep. Missouri Bot. Gard. 6:61. 1894.

Sagittaria guyanensis HBK. Nov. Gen. & Sp. 1:250. 1816.
Echinodorus guyanensis (HBK.) Griseb. Fl. Brit. W. Ind. 505. 1864.
Lophiocarpus guyanensis (HBK.) Micheli, in DC. Monogr. 3:62. 1881.

Leaves floating, broadly oval to suborbicular, cordate-sagittate, rounded at the apex, 4–7 cm. long; petioles elongate. Flowering scapes shorter than the petioles, bearing the rather few flowers at the tip; sepals ovate, 0.6–0.8 cm. long; petals white, slightly exceeding the sepals.

Mexico to Trinidad, Brazil, and Paraguay, in marshes and ponds.

COCLÉ: Aguadulce, *Pittier 4981.* PANAMÁ: Pacora, *Woodson, Allen & Seibert 729;* Río Tecúmen, *Standley 26652;* Juan Franco, *Standley 27791;* Juan Díaz, *Killip 3260.*

3. SAGITTARIA L.

SAGITTARIA L. Sp. Pl. 993. 1753; Small, N. Am. Fl. 17^1:50. 1909.

Perennial, acaulescent, marsh or aquatic herbs with thickened fleshy rhizomes. Leaves erect or floating, sagittate or attenuated at the base, the submerged frequently without blades. Inflorescences simple or branched, bearing numerous whorls of 3 flowers, the lower usually pistillate and the upper usually staminate; sepals 3, green; petals 3, white.

1. SAGITTARIA LANCIFOLIA L. Pl. Jam. Pug. 27. 1759.

Plants emersed or partially submerged, 4–20 dm. tall. Leaves erect or ascending, lanceolate to elliptic, attenuate at base and apex, 1–4 dm. long, usually shorter than the elongate petioles. Inflorescences usually longer than the leaves, simple or branched, bearing few to numerous whorls of flowers; pedicels ascending, 1.5–3.0 cm. long; sepals ovate, 0.6–1.0 cm. long, reflexed in fruit; petals 0.8–1.3 cm. long, white.

Florida and Texas to Mexico, Central and South America and the Antilles, in wet fields, ponds, and stream margins.

BOCAS DEL TORO: Isla Colón, *von Wedel 35*. CANAL ZONE: Miraflores Lake, *Hunter & Allen 773;* Gigante Bay, *Dodge 3497;* Barro Colorado Island, *Kenoyer 101;* between Corozal and Ancón, *Pittier 2163*.

BUTOMACEAE

1. LIMNOCHARIS H. & B.

LIMNOCHARIS H. & B. Pl. Aequin. 1:116. 1807; Nash, N. Am. Fl. 17^1:63. 1909.

Perennial, lactescent, aquatic or marsh plants, acaulescent from a mass of fleshy fibrous roots. Leaves narrowly lanceolate to elliptic, attenuate or rarely somewhat cordate at the base; petioles elongate and sheathing at the base. Inflorescences simple, umbellate, supported on a naked scape shorter than the leaves. Flowers perfect, pedicellate; sepals 3, greenish-yellow; petals 3, yellow; stamens numerous, the outermost sterile; carpels 15–20, laterally compressed, more or less united, thickened on the back, the sides delicately membranaceous in fruit, containing numerous seeds, dehiscent ventrally.

1. LIMNOCHARIS FLAVA (L.) Buch. Abh. Nat. Ver. Bremen 2:2. 1868.

Alisma flava L. Sp. Pl. 343. 1753.
Damasonium flavum (L.) Mill. Gard. Dict. ed. 8. 1768.
Limnocharis emarginata H. & B. Pl. Aequin. 1:116. 1807.
Limnocharis Plumieri L. C. Rich. Mém. Mus. Paris 1:374. 1815.
Limnocharis Laforesti Duchas. ex Griseb. Bonplandia 6:11. 1858.
Limnocharis flava var. *minor* Micheli, in DC. Monogr. 3:90. 1881.
Limnocharis mattogrossensis O. Ktze. Rev. Gen. 3^2:324. 1893.

Fig. 4. *Limnocharis flava*

Leaves basal, narrowly lanceolate to ovate, attenuate or cordate at the base, 1–2 dm. long, somewhat shorter than the petioles. Flowering scapes somewhat shorter than the petioles; umbels bearing 3–15 mediocre yellow flowers; pedicels stout, 2–4 cm. long; sepals greenish or yellowish, about 1 cm. long, accrescent and enveloping the fruiting head; petals somewhat surpassing the sepals.

Mexico to southern Brazil and the Antilles, in wet fields, marshes and pond margins.

CANAL ZONE: near Panama City, *Pittier 2554*. COCLÉ: Aguadulce, *Pittier 4836*. HERRERA: Pesé, *Allen 810*. PANAMÁ: Sabanas, *Standley 25940;* Río Tecúmen, *Standley 26712;* Las Cruces Trail, *Standley 29091;* Chepo, *Pittier 4679*.

Standley (Fl. Barro Colorado Isl. 20. 1933) cites *Hydrocleis nymphoides* (H. & B.) Buch. doubtfully from Barro Colorado Island *(Shattuck 401)*: "The collection consists of small sterile plants referable to this family but of uncertain generic and specific position. Further material is necessary to determine their status." *Hydrocleis* sometimes is placed in the Hydrocharitaceae.

TRIURIDACEAE

1. SCIAPHILA Blume

SCIAPHILA Blume, Bijdr. 514. 1825; Giesen, in Engl. & Diels, Pflanzenreich 4^{18}:30. 1938.

Aphylleia Champ. in Calcutta. Jour. Nat. Hist. 7:463. 1847.

Small colorless or purplish saprophytic herbs. Leaves alternate, reduced to narrow scales. Inflorescence terminal, racemose, bearing few to numerous small, monoecious, hermaphrodite or unisexual flowers. Perianth campanulate, segments virtually uniform, 4–10; stamens 2–6; carpels numerous, free; staminodia and pistillodia lacking.

1. SCIAPHILA ALBESCENS Benth. in Hook. Jour. Bot. 7:11. 1855.

Sciaphila panamensis Blake, Proc. Biol. Soc. Wash. 38:36. 1925.

Plants slender, 8–20 cm. tall, the stem usually simple. Leaves few, reduced to narrow scales. Racemes bearing 10–20 small purplish flowers. Staminate flowers about 0.4–0.5 mm. in diameter, perianth segments 6, rarely 5, ovate, exappendiculate, stamens 3, rarely 2, sessile; pistillate flowers about 0.5–0.6 mm. in diameter, perianth segments 6.

Panama to northern Brazil, in moist forests.

SAN BLAS: forests around Puerto Obaldía, *Pittier 4290*.

Fig. 5. *Sciaphila albescens*

The genus *Triuris*, with dioecious flowers and long-caudate perianth segments, has been collected in Guatemala and Colombia, and is to be expected in Panama.

GRAMINEAE

By JASON R. SWALLEN

Flowers perfect (rarely unisexual), arranged in spikelets consisting of a shortened axis (rachilla) and 2 to many 2-ranked bracts, the lowest two (glumes, rarely one or both obsolete) empty, each succeeding one or more (lemmas) bearing

in their axils a single flower (one to few of the lower lemmas sometimes barren, and the upper one or more often reduced and sterile), and between the flower and rachilla a 2-nerved bract (palea), the lemma, palea, and included flower constituting the floret; stamens 1 to many, usually 3, with delicate filaments and 2-celled anthers; pistil 1, with a 1-celled 1-ovuled ovary, 2 (rarely 1 or 3) styles, and usually plumose stigmas; fruit a caryopsis, the grain rarely free from the pericarp. Herbaceous or sometimes woody plants with round or somewhat flattened, hollow or solid stems (culms), and 2-ranked, usually parallel-veined leaves consisting of a sheath which envelops the culm, a blade, usually flat, and between the two on the inside a membranaceous or hairy appendage (ligule), this rarely obsolete.

KEY TO THE GENERA

a. Plants with woody culms, erect or often clambering. Blades petioled. (BAMBUSEAE.) (See also *Lasiacis*.)
  b. Culms in large erect clumps, usually 10 m. or more high; stamens 6; spikelets several-flowered.
    c. Culms thornless; keels of palea wingless ..... 1. BAMBUSA
    cc. Culms thorny; keels of palea winged ..... 2. GUADUA
  bb. Culms clambering, or if erect, much less than 10 m. high. Sterile lemmas 1 or 2 below the fertile florets.
    c. Spikelets with 2 or more perfect florets ..... 3. ARTHROSTYLIDIUM
    cc. Spikelets with 1 perfect floret ..... 4. CHUSQUEA
aa. Plants herbaceous (woody in *Lasiacis* with subglobose spikelets).
  b. Spikelets 1- to many-flowered, the reduced florets, if any, above the fertile florets (lower florets empty in *Uniola* and *Ctenium*); articulation usually above the glumes (below the glumes in *Zeugites*, *Cinna*, *Polypogon*, *Oryza*, and *Leersia*).
    c. Spikelets in groups of 2–5, the groups racemose along a common axis, falling entire.
      d. Groups of spikelets nodding; first glumes relatively thin, not forming an involucre ..... 36. AEGOPOGON
      dd. Groups of spikelets erect, the first glumes broad, indurate, forming a pitcher-shaped involucre around the spikelets ..... 27. ANTHEPHORA
    cc. Spikelets solitary or paired, not arranged in groups along a common axis.
      d. Lemma with a long much-contorted awn, the awns becoming tangled and remaining attached at the apex of the axis. Broad-leaved perennials ..... 5. STREPTOCHAETA
      dd. Lemma awnless, or, if awned, the awn straight or geniculate, never contorted or becoming tangled.
        e. Spikelets unisexual. Plants monoecious.
          f. Spikelets arranged in whorls in a dense spike, each whorl consisting of a sessile pistillate spikelet surrounded by 4 or 5 staminate pedicellate spikelets; stamens numerous ..... 69. PARIANA
        ff. Spikelets paniculate.
          g. Spikelets in somewhat distant pairs along the main branches, one of each pair sessile, pistillate, the other long-pedicellate, staminate, much smaller than the pistillate spikelet; stamens 6 ..... 39. PHARUS
          gg. Spikelets not in pairs as above; stamens 2 or 3.
            h. Glumes wanting, only the lemma and palea present; aquatic grasses with the staminate and pistillate spikelets in separate inflorescences ..... 40. LUZIOLA
            hh. Glumes present; terrestrial, usually forest grasses. (OLYREAE).
              i. Panicles large, terminal, the pistillate spikelets on the upper branches and toward the ends of the lower

ones, the staminate on the lower part of the lower branches ..... 58. Olyra
ii. Panicles small, axillary, or terminal and axillary, the terminal when present usually wholly staminate.
j. Fruit roughly triangular, inflated, gibbous; panicles axillary, composed of 1 terminal pistillate spikelet, and a few staminate spikelets below it.. 65. Lithachne
jj. Fruit subcylindric; panicles terminal and axillary.
k. Fruit sessile; terminal panicle, if present, wholly staminate, the axillary usually pistillate, or rarely with a few staminate or sterile spikelets on the lower branches ..... 66. Raddia
kk. Fruit raised on the enlarged and thickened segment of the rachilla ..... 67. Cryptochloa
ee. Spikelets perfect, or if unisexual, the plants dioecious.
f. Spikelets sessile or short-pedicellate on one side of a continuous rachis. (Chlorideae).
g. Spikelets 1-flowered with no rudimentary florets above the fertile one. Rachilla prolonged beyond the floret as a naked stipe ..... 31. Cynodon
gg. Spikelets 2- to several-flowered, or, if only 1-flowered, with one or more rudimentary florets above the perfect one.
h. Spikes digitate.
i. Lemma awnless or awn-pointed.
j. Rachis prolonged beyond the spikelets in a naked point..... 30. Dactyloctenium
jj. Rachis not prolonged ..... 29. Eleusine
ii. Lemma awned. Rudiment narrow or club-shaped, composed of one or more reduced sterile lemmas..... 34. Chloris
hh. Spikes solitary or racemose.
i. Spikes solitary, rarely two or three. Spikelets with two sterile florets below the fertile one. Second glume with a stout divergent awn at the middle ..... 32. Ctenium
ii. Spikes several to many, racemose.
j. Lemma entire or minutely bifid, awnless or 1-awned.
k. Rudimentary floret 1-awned, sometimes reduced to one or two bristles, rarely wanting.... 33. Gymnopogon
kk. Rudimentary floret awnless ..... 28. Leptochloa
jj. Lemma variously lobed or dentate, usually 3-awned ..... 35. Bouteloua
ff. Spikelets pedicellate in open or contracted panicles (sessile in loose spikes in *Jouvea*).
g. Spikelets 2- to several-flowered.
h. Lemmas awnless or awned from the tip, sometimes from between the teeth of a minutely bifid apex. (Festuceae).
i. Lemma or rachilla villous with long silky hairs (staminate spikelets glabrous in *Gynerium*). Tall stout reeds.
j. Plants dioecious. Culms very high with short internodes ..... 14. Gynerium
jj. Plants with perfect flowers.
k. Lemma and rachilla hairy; blades crowded at the base of the culms ..... 13. Cortaderia
kk. Lemma naked, rachilla hairy; blades distributed along the culms ..... 12. Phragmites
ii. Lemma and rachilla glabrous or pubescent but not with long silky hairs.
j. Plants dioecious. Staminate spikelets many-flowered, rather distant in a loose spike, the pistillate solitary or clustered, nearly hidden in the leaves 18. Jouvea
jj. Plants with perfect flowers.

k. Blades ovate to lanceolate with conspicuous transverse veins, most of them distinctly pedicellate.
l. Glumes narrow, acute, without transverse veins. Panicles usually large, the spikelets borne only at the ends of the fragile filiform branchlets ..... 16. ORTHOCLADA
ll. Glumes broad with prominent transverse veins, the summit irregularly toothed ..... 17. ZEUGITES
kk. Blades linear with no transverse veins.
l. Stigmas elongate, tendril-like. Spikelets distant in a long narrow 1-sided raceme ..... 15. STREPTOGYNE
ll. Stigmas not elongate.
m. Lemma 3-nerved, the palea usually persistent ..... 10. ERAGROSTIS
mm. Lemma 5- to several-nerved, the nerves sometimes obscure.
n. Spikelets with 1–4 empty lemmas below the fertile florets, large and very flat ..... 11. UNIOLA
nn. Spikelets with no empty lemmas below the fertile florets.
o. Lemmas densely pubescent on the nerves, awnless, keeled ..... 9. POA
oo. Lemmas glabrous, or pubescent all over.
p. Spikelets short-pedicellate, rather distant in a simple raceme ..... 7. BRACHYPODIUM
pp. Spikelets in open or contracted panicles.
q. Lemma awned from between the teeth of the minutely bifid apex, conspicuously compressed ..... 6. BROMUS
qq. Lemma awnless or awned from the tip, rounded or obscurely keeled ..... 8. FESTUCA
hh. Lemma awned from the back. Glumes as long as the lowest floret, usually about as long as the spikelet. (AVENEAE.) ..... 19. TRISETUM
gg. Spikelets 1-flowered.
h. Spikelets strongly laterally compressed; glumes minute or wanting; articulation below the spikelet. (ORYZEAE).
i. Glumes minute; lemmas often awned ..... 37. ORYZA
ii. Glumes wanting; lemmas awnless ..... 38. LEERSIA
hh. Spikelets terete, or at least not strongly compressed; glumes usually well developed; articulation above the glumes (below the glumes in *Cinna* and *Polypogon*). (AGROSTIDEAE).
i. Glumes awned ..... 22. POLYPOGON
ii. Glumes awnless, or, if awned, much shorter than the floret.
j. Lemma with a very short awn from just below the apex ..... 21. CINNA
jj. Lemma awnless or with a well-developed awn.
k. Fertile spikelets surrounded by numerous sterile spikelets in the form of bristles or delicate bracts ..... 23. PEREILEMA
kk. Spikelets all perfect, not surrounded by bristles.
l. Palea wanting; lemma awnless or awned from the back ..... 20. AGROSTIS
ll. Palea well developed; lemma awnless or awned from the tip.

m. Awn simple; lemma firm but not indurate; callus blunt, glabrous (sometimes pubescent or villous in *Muhlenbergia*).
n. Lemma 3–5-nerved, mucronate or awned 24. Muhlenbergia
nn. Lemma 1-nerved, obtuse or subacute 25. Sporobolus
mm. Awn trifid, the lateral ones sometimes reduced or wanting; lemma indurate; callus sharp, bearded 26. Aristida

bb. Spikelets with 1 perfect terminal floret and a sterile or staminate floret below it (both florets usually fertile in *Isachne*); articulation below the glumes (except in *Arundinella*), either in the pedicel, the rachis, or at the base of a cluster of spikelets.
c. Glumes membranaceous; fertile lemma indurate or at least as firm as the glumes; sterile lemma like the glumes in texture.
d. Fertile lemma scarcely firmer than the glumes, awned, the awns relatively long, geniculate 41. Arundinella
dd. Fertile lemma usually much firmer than the glumes, awnless or awn-tipped. (Paniceae).
e. Spikelets subtended by bristles or enclosed in spiny burs.
f. Spikelets subtended by bristles.
g. Bristles persistent 62. Setaria
gg. Bristles deciduous, falling with the spikelet 63. Pennisetum
ff. Spikelets enclosed in spiny burs 64. Cenchrus
ee. Spikelets neither subtended by bristles nor enclosed in spiny burs.
f. Spikelets arranged on one side of spike-like racemes.
g. Margins of fertile lemma thin, not inrolled.
h. Spikelets densely covered with long tawny silky hairs 43. Trichachne
hh. Spikelets glabrous or pubescent but not long-silky 44. Digitaria
gg. Margins of fertile lemma inrolled, indurate.
h. Rachilla joint and first glume adnate, forming a swollen ring-like callus 49. Eriochloa
hh. Rachilla joint and first glume neither adnate nor swollen.
i. Racemes solitary (see also *Paspalum*).
j. Spikelets sunken in a thick corky rachis; rachis disarticulating at maturity 45. Stenotaphrum
jj. Spikelets not sunken in a thick corky rachis; rachis not disarticulating at maturity.
k. Rachis rather broadly winged, partially enfolding the spikelets; spikelets paired but rather distant, appearing as if solitary in a single row, the spikelets of each pair placed back to back 46. Thrasya
kk. Rachis wingless; spikelets solitary, the back of the fertile lemma turned from the rachis 48. Mesosetum
ii. Racemes 2 to many (sometimes solitary in *Paspalum*).
j. Spikelets awned or awn-pointed.
k. First glume long-awned, the body nearly as long as the spikelet; spikelets glabrous or pubescent but not hispid 60. Oplismenus
kk. First glume awnless, less than half as long as the spikelet; spikelets hispid 61. Echinochloa
jj. Spikelets awnless.
k. Fertile lemma with small wings at the base, these sometimes reduced to scars 54. Ichnanthus
kk. Fertile lemma wingless.
l. First and second glume equal, nearly as long as the spikelet, the second becoming spiny at maturity. Racemes loosely flowered 47. Pseudechinolaena
ll. First glume not more than half as long as the spikelet, or wanting, the second as long as the spikelet, glabrous or pubescent but not spiny.
m. Back of the fruit turned away from the rachis.

n. First glume well developed ..... 50. BRACHIARIA
nn. First glume wanting ..... 51. AXONOPUS
mm. Back of the fruit turned toward the rachis.
n. First glume always present ..... 53. PANICUM
nn. First glume usually wanting (often present in *P. langei* and occasionally in other species) ..... 52. PASPALUM
ff. Spikelets paniculate (panicles dense and spike-like in *Sacciolepis* and *Hymenachne amplexicaulis*).
g. Spikelets villous with appressed or spreading hairs; first glume wanting ..... 42. LEPTOCORYPHIUM
gg. Spikelets glabrous or pubescent; first glume always present.
h. Fertile lemma with small wings at the base, these sometimes reduced to scars ..... 54. ICHNANTHUS
hh. Fertile lemma wingless.
i. Spikelets with 2 fertile florets ..... 59. ISACHNE
ii. Spikelets with only 1 fertile floret.
j. Second glume inflated, saccate at the base; spikelets unsymmetrical ..... 56. SACCIOLEPIS
jj. Second glume not inflated; spikelets symmetrical.
k. First and second glume equal, similar, as long as the spikelet. Plants widely decumbent-spreading ..... 58. HOMOLEPIS
kk. First glume rarely more than half as long as the second, dissimilar.
l. Panicles dense, spike-like or with narrowly ascending branches; fruit scarcely indurate, open at summit ..... 57. HYMENACHNE
ll. Panicles mostly open, loosely flowered, fruit indurate, closed at summit, the lemma tightly enclosing the palea.
m. Spikelets with a tuft of woolly hairs at the tip of the second glume and sterile lemma; plants woody, clambering ..... 55. LASIACIS
mm. Spikelets without woolly hairs; plants herbaceous ..... 53. PANICUM
cc. Glumes indurate; fertile lemma hyaline or membranaceous, the sterile lemma like the fertile one in texture; spikelets arranged in pairs in narrow spikes or racemes.
d. Spikelets with perfect flowers, each perfect spikelet usually paired with a staminate or reduced sterile spikelet, or sometimes all the spikelets perfect and alike. (ANDROPOGONEAE).
e. Racemes paniculate. (See also *Andropogon saccharoides*).
f. Panicles conspicuously silky; spikelets awnless.
g. Panicles white or pinkish, loose but rather dense.
h. Rachis continuous; spikelets unequally pedicellate ..... 70. IMPERATA
hh. Rachis breaking up at maturity; lower spikelet sessile, the upper pedicellate ..... 71. SACCHARUM
gg. Panicles golden brown, very dense and compact ..... 72. ERIOCHRYSIS
ff. Panicles not silky; spikelets awned. Racemes reduced to one or few joints.
g. Pedicellate spikelet staminate ..... 78. SORGHUM
gg. Pedicellate spikelet wanting, the pedicel only present .... 79. SORGHASTRUM
ee. Racemes solitary, paired, or digitate, sometimes aggregate in a large compound inflorescence, if paniculate, the racemes crowded in a dense, silky, terminal panicle.
f. Spikelets all perfect, alike.
g. Racemes solitary at the ends of the branches; spikelets awned ..... 73. POLYTRIAS
gg. Racemes digitate; spikelets awnless ..... 82. ISCHAEMUM
ff. Spikelets of each pair unlike, the lower sessile, perfect, the upper pedicellate, usually reduced (conspicuous in *Hackelochloa* and *Diectomis*).
g. Spikelets awnless.

h. Plants annual; rachis joint and the pedicel of the upper spikelet grown together. First glume of sessile spikelet globose, alveolate ..... 83. Hackelochloa
hh. Plants perennial; rachis joint and pedicel distinct.
i. Rachis joints and pedicels much thickened at the summit, glabrous; pedicellate spikelet rudimentary.... 84. Manisuris
ii. Rachis joints and pedicels not much thickened at the summit; pedicellate spikelet staminate or neuter..... 81. Elyonurus
gg. Spikelets, at least the fertile ones, awned.
h. Culms simple, usually with a single terminal erect raceme; awns plumose, 3–5 cm. long..... 80. Trachypogon
hh. Culms branching, at least toward the summit; awns glabrous or scabrous.
i. Pedicellate spikelet conspicuous, the first glume broad, awned, obscuring the spikelets; awn of fertile lemma 4–5 cm. long, geniculate; plants annual ..... 75. Dectomis
ii. Pedicellate spikelet inconspicuous; awn of fertile lemma usually less than 15 mm. long; plants perennial.
j. First glume sharply 2-keeled, at least toward the summit.
k. Spikelets of all pairs unlike, the sessile fertile, the pedicellate sterile ..... 74. Andropogon
kk. Spikelets of the lower pairs alike, staminate or neuter ..... 76. Cymbopogon
jj. First glume of sessile spikelet rounded on the back, the margins involute ..... 77. Hyparrhenia
dd. Spikelets unisexual, the staminate and pistillate spikelets in separate inflorescences or the staminate above and the pistillate below in the same spike.
e. Staminate spikelets in a terminal tassel, the pistillate in the axils of the leaves ..... 87. Zea
ee. Staminate spikelets above, the pistillate below in the same spike.
f. Spikes short, the 1- or 2-flowered pistillate portion enclosed in a bead-like sheathing bract ..... 86. Coix
ff. Spikes elongate, many-flowered, the pistillate portion breaking up into joints, not enclosed in a sheathing bract..... 85. Tripsacum

1. BAMBUSA Retz.

Bambusa Retz. Obs. Bot. 5:24. 1789.

Spikelets several-flowered, terminating short, much reduced branches of small condensed inflorescences, these approximate on the relatively slender branches of the flowering culms subtended by bract-like sheaths which are readily deciduous; inflorescence at first appearing like a single spikelet, but gradually developing short branches from the axils of the glume-like bracts, thus continuing until the inflorescence is a dense cluster of spikelets; glumes wanting; lemmas firm, obscurely several-nerved, acute or awn-tipped; keels of palea wingless; stamens 6. Tall erect bamboos growing in large clumps.

1. Bambusa vulgaris Schrad. ex Wendl. Coll. Pl. 2:26. *pl. 47*. 1808.

Culms 6–10 m. high, erect, as much as 10 cm. in diameter, at first green but finally turning yellow; sheaths (of the branches) crowded, keeled, auriculate; blades lanceolate-acuminate, rounded at the base, mostly 15–30 cm. long, 1.5–4 cm. wide, the petioles rather broad, 3–5 mm. long; spikelets 1.5 cm. long, about 6-flowered; lemmas 8–10 mm. long, acute or awn-pointed.

Commonly cultivated. Introduced from the Old World.

CANAL ZONE: Balboa, *Standley 26987*.

2. GUADUA Kunth

GUADUA Kunth, Syn. Pl. Aequin. 1:252. 1822.

Spikelets cylindrical, several-flowered, elongate, in small groups toward the ends of short, somewhat leafy flowering branches, the arrangement similar to that of *Bambusa* but the clusters of spikelets never becoming so dense; lemmas imbricate, ovate, broad and clasping at the base; keels of palea broadly winged; stamens 6.

Tall, erect bamboos, which are usually spiny, especially at the nodes of the branches.

1. GUADUA ACULEATA Rupr. ex Fourn. Compt. Rend. Acad. Sci. (Paris) 84:198. 1877.

Similar in aspect to *Bambusa vulgaris* but very spiny; spikelets as much as 6 cm. long at maturity, few- to 10-flowered; lemmas about 12 mm. long, subobtuse, apiculate, more or less pubescent on the margins.

Common in low swampy ground and jungles at low altitudes, Mexico to Brazil.

CHIRIQUÍ: Boquerón, *Allen 300*. CANAL ZONE: Culebra, *Hitchcock 7950* (sterile).

3. ARTHROSTYLIDIUM Rupr.

ARTHROSTYLIDIUM Rupr. Mém. Acad. St. Pétersb. VI. Sci. Nat. 3^1:117. 1839.

Spikelets few-flowered with one or two sterile lemmas below the fertile florets, arranged in simple racemes; stamens 3. Clambering or sometimes erect slender shrubs, with numerous, short, densely fasciculate branches.

1. ARTHROSTYLIDIUM RACEMIFLORUM Steud. Syn. Pl. Glum. 1:336. 1854.

Culms slender, as much as 5 m. long, clambering or rarely erect, the slender fascicled branches 10–50 cm. long, the fertile usually shorter than the sterile ones; sheaths minutely pubescent; blades lanceolate, mostly 5–10 cm. long, 4–12 mm. wide, densely pubescent on the lower surface at the base, otherwise glabrous or minutely pubescent; racemes 2–8 cm. long, the axis pubescent; spikelets somewhat crowded, appressed; lemmas 6–8 mm. long with an awn 1–2 mm. long, glabrous or minutely pubescent; palea slightly longer than the lemma, strongly ciliate on the keels especially toward the summit.

Moist thickets and forests at lower altitudes, southeastern Mexico to Colombia.

CANAL ZONE: Summit, *Standley 25785;* Barro Colorado Island, *Kenoyer 126; Standley 31344*. PANAMÁ: Chorrera, *Hitchcock 8150;* Río Tapia, *Hitchcock 22552½;* Río Tecúmen, *Standley 26572*.

This bamboo apparently flowers very infrequently. All the above specimens are sterile.

4. CHUSQUEA Kunth

CHUSQUEA Kunth, Syn. Pl. Aequin. 1:254. 1822.

Spikelets terete; glumes small or nearly wanting, nerveless; sterile lemmas 2, often as long as the solitary fertile floret; stamens 3. Clambering or erect shrubs with contracted panicles fascicled on the main culm or on long slender branches.

a. Blades of fertile branches much reduced, 0.5–2 cm. long; panicles composed of 1–4 spikelets ..... 1. C. SIMPLICIFLORA
aa. Blades of fertile branches scarcely reduced, more than 6 cm. long; panicles many-flowered.
b. Blades linear or narrowly lanceolate, not tessellate; spikelets 12–15 mm. long ..... 2. C. LONGIFOLIA
bb. Blades lanceolate, rounded at the base, conspicuously tessellate; spikelets about 5 mm. long ..... 3. C. SUBTESSELLATA

1. CHUSQUEA SIMPLICIFLORA Munro, Trans. Linn. Soc. Bot. 26:54. 1868.

Culms scandent or high-climbing, as much as 25 m. long, 5 mm. thick, smooth or roughly papillose above the nodes; sheaths ciliate, more or less fimbriate at the mouth; blades of the sterile shoots mostly 5–9 cm. long, 8–15 mm. wide, pilose on the lower surface at the base, otherwise glabrous, the margins scabrous; fertile shoots 2–8 cm. long in dense fascicles on long slender drooping branches, the blades 5–20 mm. long; panicles very small, composed of 1 to 4 spikelets; spikelets 8–9 mm. long, appressed; glumes thin, about 0.5 mm. long; sterile lemmas acuminate, half to two-thirds as long as the floret; fertile lemma acute, awnless, glabrous; palea about as long as the lemma, rounded on the back or sulcate only near the tip; stamens 3.5 mm. long.

Common in moist thickets and forests at low altitudes, Guatemala, Costa Rica, and Panama.

COLÓN: Catival, *Standley 30257*. CANAL ZONE: Frijoles, *Piper 5291; Standley 27433;* Empire, *Hitchcock 7952; Piper 5292;* Gamboa, *Standley 28367;* Obispo, *Standley 31669;* Cerro Gorda, *Standley 25985;* Barro Colorado Island, *Bailey & Bailey 285; Kenoyer 125;* Corozal, *Standley 27339, 29062;* Pedro Miguel, *Hitchcock 7959;* "Lion Hill Station," *Hayes 661* (TYPE); Brazos Brook Reservoir, *Stevens 698*. PANAMÁ: Río Tapía, *Hitchcock 22952; Standley 26123, 28038.*

The above specimens are nearly all sterile.

2. CHUSQUEA LONGIFOLIA Swallen, Jour. Washington Acad. Sci. 30:210. 1940.

Main culm about 5 mm. thick (in the flowering portion), the flowering branches fascicled, ascending, 20–60 cm. long; blades 12–25 cm. long, 6–12 mm. wide, glabrous, the margins scabrous; panicles 10–16 cm. long, narrow, the slender branches appressed, scabrous; spikelets 12–13 mm. long, appressed; glumes obtuse, nerveless, the first 0.5 mm. long, the second 1 mm. long; first sterile lemma 7–9 mm. long, 9-nerved, acute, mucronate, very broad at the base; second sterile lemma about as long as the spikelet, 9-nerved, acuminate, scabrous toward the tip; fertile lemma 11–12 mm. long, obscurely nerved, acuminate, puberulent, minutely bifid, mucronate or with an awn 2–4 mm. long; palea as long as or a little longer than the lemma, bidentate, broad and rounded toward the base, keeled near the summit, the keels approximate, the margins very broad, incurved.

Forests, 1300 to 2450 meters, Mexico (Chiapas), Costa Rica and Panama.

CHIRIQUÍ: Volcán de Chiriquí, *Hitchcock 8200; Pittier 3085.*

3. CHUSQUEA SUBTESSELLATA Hitchc. Proc. Biol. Soc. Washington 40:81. 1927.

Culms erect, 1–3 m. high; sheaths pubescent, becoming glabrous; blades appressed, 5–10 cm. long, 8–15 mm. wide, acuminate or subattenuate, firm, tessellate-veined, the margins indurate, scabrous; panicles 7–15 mm. long, dark purple, narrow, condensed or somewhat loose, the rachis and appressed branches densely appressed-pubescent; spikelets 5–6 mm. long; glumes obtuse, the first 1 mm. long, the second 2 mm. long; sterile lemmas acute or apiculate, 5-nerved, more or less scabrous on the nerves, two-thirds to three-fourths as long as the spikelet; fertile lemma acute or apiculate, scabrous near the tip; palea a little shorter than the lemma, rounded on the back, but keeled and somewhat sulcate at the tip.

Forming dense thickets on paramos, alt. 2700 to 3000 meters, Costa Rica (Cerro de la Muerta and Cerro de las Vueltas) and Panama.

CHIRIQUÍ: Volcán de Chiriquí, *Pittier 3069.*

5. STREPTOCHAETA Schrad.

STREPTOCHAETA Schrad. ex Nees, Agrost. Bras. 536. 1829.

Spikelets 1-flowered, terete, disarticulating below the glumes; empty bractlets (probably glumes and sterile lemmas) 4, much shorter than the spikelet, more or less toothed; lemma indurate, gradually narrowed into a long much contorted awn; palea shorter than the lemma, bifid to the base, indurate like the lemma; inner bracts (lodicules) 3, imbricate, longer than the palea, firm but less indurate than the lemma and palea; stamens 6, monadelphous, the tube about as long as the lemma; style 1, stigmas 3. Broad-leaved perennials with the spikelets in usually elongate spikes.

a. Blades 6–9 cm. wide; spikelets, excluding awns, about 14 mm. long; spike dense, usually many-flowered ..... 1. S. SODIROANA
aa. Blades 3–4.5 cm. wide; spikelets, excluding awns, about 22 cm. long; spike few-flowered, the spikelets distant ..... 2. S. SPICATA

1. STREPTOCHAETA SODIROANA Hack. Oesterr. Bot. Zeitschr. 40:113. 1890.

Perennial; culms erect or rarely decumbent at the base and rooting at the lower nodes, 60–100 cm. high, densely pubescent below the inflorescence; lower sheaths much shorter than the internodes, the upper ones crowded, flattened but scarcely keeled, glabrous, broadened at the truncate, more or less auriculate, densely ciliate mouth; ligule obsolete; blades 18–30 cm. long, 6–9.5 cm. wide, petiolate, asymmetrical, rather abruptly acute or acuminate, glabrous; spike 20–30 cm. long, about 1 cm. thick, densely many-flowered; the axis and the pedicels of the spikelets conspicuously hispid; spikelets appressed, somewhat obscured by the awns; lower bracts very short, obscure, irregularly lobed; lemma about 12 mm. long, tapering into an awn 10 cm. long, the lower part (about 6 cm.) nearly straight, the upper part much finer, minutely but conspicuously contorted; palea 8–9 mm.

long, the lobes acute, somewhat spreading at the tip; lodicules unequal, 13–15 mm. long, somewhat exceeding the lemma.

Moist or wet forests at low altitudes, often common, British Honduras to Panama; Ecuador.

CHIRIQUÍ: Cerro de la Plata, *Pittier 5164.* CANAL ZONE: Nueva Limón, *Maxon 6896;* Barro Colorado Island, *Standley 31374, 41084; Kenoyer 103; Maxon, Harvey & Valentine 6824;* Juan Mina, *Bartlett & Lasser 16790.*

2. STREPTOCHAETA SPICATA Schrad. ex Nees, Agrost. Bras. 537. 1829.

Fig. 6. *Streptochaeta spicata*

Perennial; culms 60–90 cm. high, simple or sparingly branched, pubescent at and below the nodes; lower sheaths shorter than the internodes, the upper somewhat crowded, pilose on the margins toward the base, hispid-ciliate at the mouth, often auriculate, the auricles as much as 7 mm. long; blades 8–15 cm. long, 2.5–4.5 cm. wide, acute, nearly symmetrical, glabrous; spike 10–12 cm. long, bearing 5–9 erect spikelets, the axis densely pubescent; spikelets 20–24 mm. long; lower bracts 2–3 mm. long, the first two narrow, awned, the other two very broad, awnless, strongly nerved, irregularly dentate; lemmas as long as or a little shorter than the lodicules, tapering into an awn 7–10 cm. long, becoming slender and finally contorted in the upper third; divisions of the palea acuminate, 14–15 mm. long.

Wet forests, Guatemala and Trinidad to Ecuador and Brazil.

CHIRIQUÍ: San Felix (Cerro de la Plata), *Pittier 5164½.* CANAL ZONE: Frijoles, *Standley 27489.* PANAMÁ: between Pinogana and Yavisa, *Allen 245.*

6. BROMUS L.

BROMUS L. Sp. Pl. 76. 1753.

Ceratochloa Beauv. Ess. Agrost. 75, *pl. 15, f. 7.* 1812.

Spikelets several-flowered, the rachilla disarticulating above the glumes and between the florets; glumes acute, the first 1- or obscurely 3-nerved, the second 3- to 5-nerved; lemmas keeled, 5- to 9-nerved, awned from between the teeth of the minutely bifid apex; palea shorter than the lemma, thin, ciliate on the keels, adherent to the caryopsis.

Slender perennials with closed sheaths, flat narrow blades, and open panicles of relatively large spikelets.

1. BROMUS EXALTATUS Bernh. Linnaea 15: Litt. 90. 1841.

Bromus subalpinus Rupr. ex Fourn. Mex. Pl. 2:128. 1886.

Perennial; culms erect from a more or less decumbent base, 0.5 to more than 1 m. high, retrorsely pilose at the nodes; sheaths longer than the internodes or the

upper ones shorter, appressed- or spreading-pilose especially toward the summit; ligule membranaceous, erose, about 1 mm. long; blades flat, mostly 15–30 cm. long, 3–5 mm. wide, rarely wider, scabrous, more or less pilose toward the base; panicles 10–20 cm. long, nodding, the slender drooping branches naked below, bearing 1–3 spikelets; glumes narrow, acuminate, subequal or the second longer, the first 1- or obscurely 3-nerved, 8–12 mm. long; lemmas mostly 12–15 mm. long, acuminate, rather evenly hairy across the back, the awn 4–7 mm. or sometimes as much as 1 cm. long.

Savannas at higher altitudes, Mexico, Guatemala, and Panama.

CHIRIQUÍ: Volcán de Chiriquí, *Hitchcock 8214; Woodson & Schery 408.*

7. BRACHYPODIUM Beauv.

BRACHYPODIUM Beauv. Ess. Agrost. 100, 155. 1812.

Spikelets several-flowered, subterete except in anthesis, short-pedicelled, usually appressed, rather distant in simple racemes; glumes strongly nerved, the second broader and a little longer than the first; lemmas rounded on the back, obscurely nerved, awned from the tip; palea about as long as the lemma, strongly ciliate on the keels; caryopsis adnate to the palea.

1. BRACHYPODIUM MEXICANUM (Roem. & Schult.) Link, Hort. Berol. 1:41. 1827.

Festuca mexicana Roem. & Schult. Syst. Veg. 2:732. 1817.

Perennial; culms slender, wiry, branching, usually geniculate-spreading, 15–90 cm. long, sparsely pilose, densely bearded at the nodes; sheaths much shorter than the internodes, pilose; ligule 2–3 mm. long, erose-ciliate; blades 5–12 cm. or sometimes as much as 20 cm. long, 2–5 mm. wide, scabrous, sparsely to rather densely pilose on the upper surface; racemes 4–12 cm. long, sometimes reduced to one or two spikelets; spikelets 2–2.5 cm. long, 4- to 8-flowered, the pedicels 2–3 mm. long, densely pubescent; glumes subobtuse, the first 6–9 mm. long, the second 8–11 mm. long, glabrous; lemma of lowest floret 8–10 mm. long, scabrous at least toward the summit, the awn mostly 2–5 mm. long, or rarely as much as 1 cm. long.

Moist thickets and shady banks at higher altitudes, Mexico to Bolivia.

CHIRIQUÍ: Volcán de Chiriquí, *Woodson, Allen & Seibert 1058; Hitchcock 8210.*

8. FESTUCA L.

FESTUCA L. Sp. Pl. 73. 1753.

Densely tufted perennials with flat or loosely involute blades and narrow or open panicles. Spikelets few- to several-flowered, the rachilla disarticulating above the glumes and between the florets; glumes narrow, unequal, the first 1-nerved, the second 3-nerved; lemmas rounded on the back, awnless or awned from the tip; palea not adhering to the caryopsis.

a. Blades flat, 4–10 mm. wide.
  b. Lemmas awnless, 6–7 mm. long; blades relatively firm, 5–10 mm. wide ..... 1. F. AMPLISSIMA
  bb. Lemmas awn-pointed or awned, 12–15 mm. long; blades relatively soft, 4–6 mm. wide ..... 2. F. CHIRIQUENSIS
aa. Blades involute ..... 3. F. DOLICHOPHYLLA

1. FESTUCA AMPLISSIMA Rupr. Bull. Acad. Sci. Brux. 9^2:236. 1842; Fourn. Mex. Pl. 2:125. 1886.

Uniola muelleri Fourn. Mex. Pl. 2:122. 1886.

Coarse perennial; culms erect, as much as 2 m. high, scabrous or nearly smooth; sheaths scabrous, shorter than the internodes, the lowermost becoming fibrous with age; blades 15–75 cm. long, 5–10 mm. wide, flat, firm, scabrous, acuminate or attenuate to a fine involute tip; ligule very short; panicles 20–30 cm. long, open, the branches slender, more or less flexuous, ascending or spreading, naked at the base, the lower ones usually about 15 cm. long, or sometimes as much as 25 cm. long; spikelets 8–15 mm. long, 4- to 7-flowered; glumes acute or acuminate, the first 4–6 mm. long, 1- to 3-nerved, the second 5–7 mm. long, 3-nerved; lemmas 7–8 mm. long, acute or acuminate, smooth or somewhat scabrous toward the tip, awnless or mucronate.

Savannas and open woods at rather high altitudes, Mexico to Panama.

CHIRIQUÍ: Volcán de Chiriquí, *Hitchcock 8208, 8226; Davidson 1043*.

2. FESTUCA **chiriquensis** Swallen, sp. nov.

Perennis; culmi 80–100 cm. alti, erecti, caespitosi, glabri; vaginae internodiis multo longiores, glabrae, infimae fibrosae; ligula hyalina ca. 1 mm. longa; laminae 15–30 cm. longae, 4–6 mm. latae, tenues, laxae, lucidae, glabrae, marginibus scabris; paniculae 15–25 cm. longae, ramis gracilibus, pendulis, scabris, ad 12 cm. longis, in parte inferiore nudis; spiculae 15–18 mm. longae, 3–4-florae; glumae angustae, acuminatae, prima 8 mm. longa, 1-nervis, secunda 9–10 mm. longa, 1–3-nervis; lemmata scabra, nervosa, primum 14–15 mm. longum; aristae 1–3 mm. longae.

Perennial; culms cespitose, erect, 80–100 cm. high, glabrous; sheaths usually much longer than the internodes, loose, glabrous, the lowermost becoming fibrous with age; ligule about 1 mm. long, hyaline; blades 15–30 cm. long, 4–6 mm. wide, soft, lax, shining, glabrous, the margins scabrous; panicles 15–25 cm. long, nodding, the slender branches drooping, naked in the lower half, scabrous, as much as 12 cm. long; spikelets 15–18 mm. long, 3- to 4-flowered; glumes narrow, acuminate, the first about 8 mm. long, 1-nerved, the second 9–10 mm. long, 1- to 3-nerved; lemmas scabrous, distinctly nerved, the first 14–15 mm. long, the upper ones successively shorter, the awns 1–3 mm. long.

Savannas and open places in woods at medium to rather high altitudes, Panama.

CHIRIQUÍ: Volcán de Chiriquí, *Hitchcock 8225;* open places in woods, 1300–1500 m. alt., Sept. 29-30, 1911, *Hitchcock 8197* (TYPE).

3. FESTUCA DOLICHOPHYLLA Presl, Rel. Haenk. 1:258. 1830.

Perennial; culms densely cespitose, erect, 70–100 cm. high, smooth, shining;

sheaths glabrous, the lower ones crowded, the upper ones elongate but much shorter than the internodes; ligule very short, minutely ciliate; blades loosely involute, firm, erect, glabrous, 15–25 cm. long, the uppermost reduced; panicles 10–15 cm. long, the branches solitary or in pairs, rather distant, spreading, or erect at maturity, the lowermost as much as 10 cm. long; spikelets about 8 mm. long, 4- to 5-flowered; first glume narrow, 1-nerved, 4–6 mm. long, the second broader, obscurely 3-nerved, 6–8 mm. long; lemmas 5–7 mm. long, scabrous, awnless or awn-tipped.

Savannas at high altitudes, Panama to Chile.

CHIRIQUÍ: Volcán de Chiriquí, *Hitchcock 8220, 8227; Killip 4550.*

9. POA L.

Poa L. Sp. Pl. 67. 1753.

Spikelets 2- to several-flowered, the rachilla disarticulating above the glumes and between the florets, the uppermost floret reduced or rudimentary; glumes acute, the first 1-nerved, the second usually 3-nerved; lemmas acute or subobtuse, 5-nerved, usually pubescent on the nerves, sometimes webbed at the base, the tip and margins often scarious.

Annuals or perennials with flat or folded blades, boat-shaped at the tip, and open or contracted panicles.

1. Poa annua L. Sp. Pl. 68. 1753.

Aira pumila Pursh, Fl. Amer. Sept. 1:76. 1814.
Poa infirma H.B.K. Nov. Gen. & Sp. 1:158. 1816.
Megastachya infirma Roem. & Schult. Syst. Veg. 2:585. 1817.
Catabrosa pumila Roem. & Schult. Syst. Veg. 2:696. 1817.
Poa aestivalis Presl, Rel. Haenk. 1:272. 1830.
Eragrostis infirma Steud. Nom. Bot. ed. 2. 1:563. 1840.
Poa annua var. *rigidiuscula* L. H. Dewey, Contr. U. S. Nat. Herb. 3:262. 1895.

Soft, erect or decumbent-spreading annual; culms flattened, commonly 5–20 cm. high, glabrous; sheaths thin with hyaline margins, mostly longer than the internodes; ligule hyaline, about 5 mm. long; blades flat, mostly 5–10 cm. long, 1–3 mm. wide, the margins scabrous; panicle 3–10 cm. long, open with rather short ascending to spreading branches; spikelets short-pedicelled, crowded, 3- to 6-flowered; first glume 1.5–2 mm., the second 2–2.5 mm. long; lemmas about 3 mm. long, subobtuse, distinctly nerved, densely pubescent on the nerves, not webbed at the base.

Open ground and waste places, in cool or temperate regions. Introduced in America from Europe, occurring from Labrador to Alaska southward throughout the United States; also in tropical America at higher altitudes.

Annual blue-grass.

CHIRIQUÍ: New Switzerland, central valley of Río Chiriquí Viejo, *Allen 1378.*

10. ERAGROSTIS Host

Eragrostis Host, Icon. Gram. Austr. 4:14. *pl. 24.* 1809.
Neeragrostis Bush, Trans. Acad. Sci. St. Louis 13:178. 1903.

Spikelets few- to many-flowered, the rachilla disarticulating above the glumes and between the florets, or continuous, the lemmas deciduous, the paleas persistent; glumes acute or acuminate, 1-nerved, or the second rarely 3-nerved, much shorter than the spikelet; lemmas acute or acuminate, keeled or rounded on the back, 3-nerved, the nerves prominent or sometimes obscure; palea 2-nerved, often ciliate on the keels.

Annuals or perennials with open or contracted panicles of small or rather large spikelets.

a. Plants annual.
  b. Palea prominently ciliate on the keels. Low delicate grasses.
    c. Panicles open, loose, the branches spreading ..... 1. E. AMABILIS
    cc. Panicles dense, spike-like, the branches closely appressed ..... 2. E. CILIARIS
  bb. Palea not prominently ciliate on the keels.
    c. Culms creeping, freely branching, forming dense soft mats ..... 3. E. HYPNOIDES
    cc. Culms not creeping or forming mats, erect or geniculate at the lower nodes.
      d. Spikelets grayish-green, pedicellate in open panicles, the lemmas subobtuse ..... 4. E. TEPHROSANTHOS
      dd. Spikelets pale, tinged with red or reddish-brown, subsessile, fascicled on the branches.
        e. Lemmas 2–2.5 mm. long, abruptly acute; spikelets mostly 6–10 mm. long ..... 5. E. MAYPURENSIS
        ee. Lemmas 5 mm. long, gradually narrowed from the base; spikelets 10–30 mm. long ..... 6. E. SIMPLICIFLORA
aa. Plants perennial.
  b. Culms 15–60 cm. high, slender; spikelets 4–5 mm. long, 6–12-flowered ..... 7. E. ACUTIFLORA
  bb. Culms 1–2 m. high, relatively stout; spikelets 5–10 mm. long, 10–16-flowered ..... 8. E. DOMINGENSIS

1. Eragrostis amabilis (L.) Wight & Arn. ex Nees in Hook. & Arn. Bot. Beechey's Voy. 251. 1838.

Poa amabilis L. Sp. Pl. 68. 1753.
Poa plumosa Retz. Obs. Bot. 4:20. 1786.
Eragrostis plumosa Link, Hort. Berol. 1:192. 1827.

Fig. 7.
Eragrostis amabilis

Annual; culms slender, erect or geniculate-spreading, 10–40 cm. high; blades flat, 4–10 cm. long, 2–4 mm. wide, acuminate, glabrous; sheaths glabrous, with a prominent tuft of hairs at the throat; panicles oblong, 3–12 cm. long, 1.5–3 cm. wide, the short branches stiffly ascending or spreading, 1–2.5 cm. long; spikelets mostly 1.5–2 mm. long, 4- to 6-flowered; lemmas 1 mm. long, obtuse, the palea conspicuously ciliate, the hairs about 0.3 mm. long.

A common weed in fields and waste places, in warmer regions of the world. Introduced in America.

CHIRIQUÍ: David, *Hitchcock 8374.* CANAL ZONE: Mt. Hope, *Standley 28849;* Darién, *Standley 31512;* Gamboa, *Standley 28489;* Summit, *Standley 30083;* Ancón, *Bro. Celestine 21; Killip 4181; Piper 5232;* Balboa, *Hitchcock 8061; Standley 25621.* COLÓN: Colón, *Rose 22081, 23993.*

2. ERAGROSTIS CILIARIS (L.) R. Br. in Tuckey, Narr. Exp. Congo App. 478. 1818.

Poa ciliaris L. Syst. Nat. ed. 10. 2:875. 1759.

Annual; culms slender, branching, erect to decumbent-spreading, 10–40 cm. or rarely as much as 60 cm. high; sheaths glabrous or sparsely papillose-pilose, with a tuft of long hairs at the throat; blades flat, acuminate or attenuate, 4–10 cm. long, 2–4 mm., rarely 5 mm., wide, glabrous or sparsely pilose with long hairs; panicles dense, spike-like, interrupted toward the base, 5–12 cm. long; spikelets 2–3 mm. long, 6- to 10-flowered, nearly sessile; lemmas 1 mm. long; palea conspicuously ciliate on the keels, the hairs about 0.5 mm. long.

Fields and waste places, especially in sandy soil. Warmer regions of both hemispheres.

BOCAS DEL TORO: *Carleton 220.* CHIRIQUÍ: David, *Hitchcock 8373.* COLÓN: Colón, *Rose 22068; Hitchcock 8032.* CANAL ZONE: Toro Point, *Hitchcock 8052;* Gatuncillo, *Piper 5289;* Frijoles, *Killip 4295;* Darién, *Standley 31577;* Culebra, *Pittier 2085; Hitchcock 7925;* Balboa, *Standley 26112; McBride & Featherstone 44.* PANAMÁ: Bella Vista, *Killip 4044;* Point Chamé, *Hitchcock 8161;* Taboga Island, *Hitchcock 8072.*

3. ERAGROSTIS HYPNOIDES (Lam.) B.S.P. Prel. Cat. N. Y. 69. 1888.

Poa hypnoides Lam. Tabl. Encycl. 1:185. 1791.
Megastachya hypnoides Beauv. Ess. Agrost. 74, 167, 175. 1812.
Poa reptans var. *caespitosa* Torr. Fl. North. & Mid. U. S. 1:115. 1823.
Neeragrostis hypnoides Bush, Trans. Acad. Sci. St. Louis 13:180. 1903.
Erosion hypnoides Lunell, Amer. Midl. Nat. 4:221. 1915.

Stoloniferous, widely spreading annual, forming dense mats; culms very slender, 5–10 cm. high; blades 1–2 cm. long, flat or becoming loosely involute, stiffly spreading; panicles pale, dense, subcapitate, 1–2 cm. long, nearly as broad; spikelets 5–12 mm. long, few- to many-flowered, on short stiff pedicels; glumes unequal, the first 1 mm. long, the second 1.5 mm. long, broader than the first; lemmas 1.5–2 mm. long, acute, rather broad at the base with thin margins; anthers 0.2 mm. long.

Lake shores, stream banks, ditches, and wet places, United States and the West Indies to Argentina.

COCLÉ: El Valle de Antón, *Hunter & Allen 378.* COLÓN: Fató, *Pittier 4146.* CANAL ZONE: between France Field, Canal Zone, and Cativa1, Panama, *Standley 30271;* Juan Mina, *Bartlett & Lasser 16360.*

4. ERAGROSTIS TEPHROSANTHOS Schult. Mant. 2:316. 1824.

Annual; culms slender, erect or geniculate-spreading, 10–30 cm. high; blades lax, flat, acuminate, 4–15 cm. long, 2–4 mm. wide, glabrous; panicles lax, open, 5–12 cm. long, pilose in the axils, the branches spreading, naked at the base, often rather densely flowered; spikelets plumbeous, 4–6 mm. long, 1.5 mm. wide, 6- to

12-flowered, short-pedicellate, usually somewhat spreading, the first glume 1 mm. long, the second about 1.3 mm. long; lemmas 2 mm. long, subobtuse.

A common weed in fields and waste places, southern United States and the West Indies to Brazil.

BOCAS DEL TORO: Laguna de Chiriquí, *Hart 91;* Bocas del Toro, *Carleton 29;* Changuinola Valley, *Dunlap 29a.* CHIRIQUÍ: El Boquete, *Hitchcock 8279; Killip 4506;* David, *Hitchcock 8379.* COLÓN: Colón, *Rose 23994.* CANAL ZONE: Gatuncillo, *Killip 4166;* Gatún, *Standley 27319;* Frijoles, *Killip 4297, 4299; Standley 27652, 31476; Pittier 6842;* Culebra, *Hitchcock 7927;* Summit, *Standley 30080;* Balboa, *Standley 30900; Bro. Gervasius 1; Porterfield 10.* PANAMÁ: Panamá, *Hitchcock,* in 1911.

Fig. 8. *Eragrostis hypnoides*

5. ERAGROSTIS MAYPURENSIS (H.B.K.) Steud. Syn. Pl. Glum. 1:276. 1854.

Poa maypurensis H.B.K. Nov. Gen. & Sp. 1:161. 1816.
Poa vahlii Roem. & Schult. Syst. Veg. 2:563. 1817.
Eragrostis vahlii Nees, Agrost. Bras. 499. 1829.
Eragrostis amoena Presl, Rel. Haenk. 1:275. 1830.
Eragrostis panamensis Presl, Rel. Haenk. 1:277. 1830.
Megastachya amoena Fourn. Mex. Pl. 2:118. 1886.
Megastachya panamensis Fourn. Mex. Pl. 2:118. 1886.

Annual; culms erect or decumbent at the base, 10–40 cm. or sometimes as much as 65 cm. high; sheaths glabrous, shorter than the internodes; blades flat, attenuate, mostly 6–15 cm. long, rarely longer, 2–4 mm. wide, papillose-pilose, especially on the upper surface, or nearly glabrous; panicles 8–15 cm. long, erect, the somewhat distant solitary branches stiffly ascending, spikelet bearing nearly to the base, densely pilose in the axils; spikelets 6–10 mm. long, 8- to 28-flowered, short-pedicellate, somewhat spreading, usually tinged with red or purple; glumes acuminate, as long as the lowest floret; lemmas 2–2.5 mm. long, broad at the base, rather abruptly narrowed above the middle to an acute or acuminate tip.

Wet or dry savannas, fields, moist thickets, and waste places, southern Mexico to Brazil and Bolivia.

CHIRIQUÍ: San Felix, *Pittier 5184;* David, *Hitchcock 8378.* COCLÉ: Aguadulce, *Pittier 4851, 4864.* CANAL ZONE: Mt. Hope, *Standley 28799;* Corozal, *Hitchcock 9191; Standley 29026.* PANAMÁ: Río Indio, *Dodge & Allen 17380;* Río Azote Caballo, *Dodge, Steyermark & Allen 16857;* Abalaba, *Killip 4270;* Río Tapia, *Hitchcock 22950; Standley 28165;* Bella Vista, *Standley 25366;* Punta Paitilla, *Standley 26267;* Río Tecúmen, *Standley 26645, 29395;* Matías Hernández, *Pittier 6889, 6919; Standley 31859;* Pacora, *Killip 4199;* Río Pacora, *Killip 4226;* Chepo, *Pittier 4768; Hunter & Allen 81.*

6. ERAGROSTIS SIMPLICIFLORA (Presl) Steud. Syn. Pl. Glum. 1:278. 1854.

Megastachya simpliciflora Presl, Rel. Haenk. 1:283. 1830.

Annual; culms tufted, often dense, spreading or prostrate, 10–40 cm. long, rather freely branching at the lower nodes; blades 4–12 cm. long, 2–4 mm. wide, acuminate, pilose on the upper surface; panicles 2–10 cm. long, rather dense, usually purple-tinged, the short stiff branches ascending to spreading, spikelet bearing to the base, often so numerous on the branches that the whole plant appears to be a dense inflorescence; spikelets sessile or nearly so, narrow, 1–3 cm. long, 10- to 30-flowered, solitary or in groups of 2–4, appressed; lemma 5 mm. long, acuminate, gradually narrowed from the base, the lateral nerves double; palea half as long as the lemma, narrow, lunate.

Savannas, at low and medium altitudes, Mexico to Panama.

COCLÉ: Aguadulce, *Pittier 4838, 4900.* PANAMÁ: Aguarubia, *Killip 4273;* Las Cruces Trail, *Cornman 2611.*

7. ERAGROSTIS ACUTIFLORA (H.B.K.) Nees, Agrost. Bras. 501. 1829.

Poa acutiflora H.B.K. Nov. Gen. & Sp. 1:161. 1816.

Perennial; culms tufted, erect, 15–60 cm. high; sheaths glabrous, more or less hairy in the throat, mostly shorter than the internodes; blades rather firm, mostly 5–20 cm. long, 2–4 mm. wide, glabrous or sparsely pilose; panicles 8–30 cm. long, the branches stiffly ascending to spreading, the lower ones sometimes as much as 10 cm. long, pilose in the axils; spikelets 4–5 mm. long, 6- to 12-flowered, rarely more, short-pedicellate, usually crowded, appressed; lemma about 2 mm. long, acute, or subacuminate, scabrous on the keel near the summit.

Moist savannas, fields and waste places, especially along ditches, Trinidad and British Honduras to Brazil and Bolivia.

CHIRIQUÍ: Dolega, *Hitchcock 8336;* David, *Hitchcock 8353.* COCLÉ: Aguadulce, *Pittier 4891, 4930.* CANAL ZONE: Gatún, *Hitchcock 7975;* Culebra, *Hitchcock 7930;* Corozal, *Hitchcock 7986;* Ancón, *Killip 4119;* Chivi Chivi Trail, *Killip 4087.* PANAMÁ: Matías Hernández, *Pittier 6780, 6920; Standley 32019;* Panamá, *Hitchcock 8407;* Chorrera, *Hitchcock 8137, 8153, 8154½;* Pacora River, *Killip 4227;* Chepo, *Pittier 4524.*

8. ERAGROSTIS DOMINGENSIS (Pers.) Steud. Syn. Pl. Glum. 1:278. 1854.

Poa domingensis, Pers. Syn. Pl. 1:88. 1805.
Eragrostis maxima Fourn. Mex. Pl. 2:114. 1886.

Perennial; culms relatively stout, erect, mostly 1–2 m. high, frequently with a few branches from the middle nodes; sheaths firm, usually longer than the internodes; blades firm, flat, elongate, attenuate, as much as 7 mm. wide, smooth beneath, scabrous on the upper surface and on the margins; panicle narrow, dense, elongate, the branches ascending or appressed, floriferous to the base; spikelets 5–10 mm. long, 10- to 16-flowered, appressed, the pedicels much shorter than the spikelets; glumes acute, about 1 mm. long; lemmas 1.8–2 mm. long, acute; palea nearly as long as the lemma.

Brackish marshes, often growing in large clumps, the West Indies and southeastern Mexico to Colombia.

PANAMÁ: Bella Vista, *Killip 4039;* Panamá, *Hitchcock 8100.*

11. UNIOLA L.

UNIOLA L. Sp. Pl. 71. 1753.
Chasmanthium Link, Hort. Berol. 1:159. 1827.

Spikelets laterally compressed, few- to several-flowered, the rachilla disarticulating above the glumes and between the florets (tardily or not at all disarticulating in our species), with 1–4 empty lemmas below the fertile florets; glumes narrow, compressed-keeled, acute or acuminate, the first 1- to 5-nerved, the second 3- to 5-nerved; lemmas compressed-keeled, 5- to several-nerved, the nerves often obscure, acute or acuminate, awnless or sometimes mucronate; palea shorter than the lemma, the keels straight (in our species) or prominently bowed.

Slender to coarse perennials with flat or convolute blades and open or usually narrow and rather dense panicles of compressed spikelets.

1. UNIOLA PITTIERI Hack. Oesterr. Bot. Zeitschr. 52:309. 1902.

Stout, glabrous, extensively stoloniferous perennial; culms in large coarse clumps 55–100 cm. high, some of the internodes elongate with 2–4 very short ones between them, the leaves thus appearing in groups; sheaths rounded, glabrous, villous in the throat and on the margins; blades elongate, very firm, attenuate to a fine tip, 8–10 mm. wide toward the base, flat but soon becoming convolute, usually curled toward the ends, glabrous below, more or less scabrous on the upper surface and on the margins; panicles usually 20–30 cm. long, 3–6 cm. wide, dense, interrupted below; spikelets very shortly pedicellate, very flat, 1–2 cm. long, 8–10

mm. wide; lemmas ovate, acute, ciliate on the keel, the margins densely villous at the base, otherwise glabrous; palea about two-thirds as long as the lemma, narrow, the keels not bowed out, ciliate with fine hairs which protrude beyond the margin of the lemma.

Sandy sea beaches, Mexico to Ecuador.

Fig. 9. *Uniola pittieri*

CHIRIQUÍ: *Pittier 5745.* CANAL ZONE: Balboa, *Standley 27151.* PANAMÁ: Bella Vista, *Killip 4034, 12018;* Panamá, *Pittier 4071; Hitchcock 8098;* Point Chamé, *Hitchcock 8155;* Taboga Island, *Hitchcock 8070; Woodson, Allen & Seibert 1493;* Perlas Islands, *Allen 2587.*

12. PHRAGMITES Trin.

PHRAGMITES Trin. Fund. Agrost. 134. 1820.

Spikelets several-flowered, the rachilla densely covered with long fine silky

hairs, disarticulating above the glumes and at the base of each segment between the florets, the first floret staminate or neuter, the others perfect; glumes unequal, narrow, acute, the first 1-nerved, the second 3-nerved; lemmas narrow, long-acuminate, each one successively smaller, the summits of all of them thus about equal; palea of staminate or neuter floret one-fourth as long as the lemma, that of the first fertile floret one-half as long as the lemma.

Coarse rhizomatous stoloniferous reed-like perennial with firm flat blades and large silky plume-like panicles.

1. PHRAGMITES COMMUNIS Trin. Fund. Agrost. 134. 1820.

Coarse rhizomatous stoloniferous perennial, usually growing in large colonies; culms erect, reed-like, 2–5 m. high; sheaths glabrous, much longer than the internodes; blades as much as 50 cm. long, 1–2.5 cm. wide, flat, firm, attenuate-pointed, with very scabrous margins; panicles 25–50 cm. long, plume-like, drooping, the branches naked below, densely villous in the lower axils; spikelets 12–20 mm. long; glumes unequal, the first 4–5 mm. long, the second 6–8 mm. long; lemma 10–13 mm. long, narrowly acuminate; rachilla hairs more than half as long as the lemma.

Marshes and wet places in temperate regions around the world, extending into the Tropics.

CHIRIQUÍ: El Boquete, *Hitchcock 8261*. COLÓN: Colón, *Piper 5231*. CANAL ZONE: Barro Colorado Island, *Bailey & Bailey 102*; Gatún Lake, *D. H. Popenoe 46*.

13. CORTADERIA Stapf

CORTADERIA Stapf, Gard. Chron. III. 22:378, 396. 1897.

Spikelets several-flowered, the rachilla disarticulating near the base of each segment forming a stipe to the floret, the lower part of the stipe glabrous, the upper part covered with long silky hairs; glumes narrow, long-acuminate, 1-nerved, longer than the first floret, sometimes longer than all the florets (in our species); lemmas 3-nerved, villous with long silky hairs, long-acuminate, tapering to a thin fine point, or awned from between the thin slender teeth of a bifid apex; palea about as long as the lemma.

Low or usually tall coarse tussock grasses, the leaves mostly crowded toward the base of the plant, with firm, elongate blades tapering to a slender point, very scabrous on the margins, and rather small to large, dense, silky, plume-like panicles.

1. CORTADERIA NITIDA (H.B.K.) Pilger, Bot. Jahrb. (Engler) 37:375. 1906.

Coarse erect perennial; culms 1–1.5 m. high; sheaths all longer than the internodes, glabrous, the lowermost crowded, becoming flattened and coiled at the base of the plant with age; blades elongate, 3–5 mm. wide, flat but becoming involute, very scabrous on the margins, hairy on the upper surface toward the base; panicles 10–30 cm. long, silvery or tinged with gold or purple, the branches ascending or spreading, rather lax, sometimes naked at the base; spikelets 10–14 mm. long, mostly 3-flowered, the glumes narrow, acuminate, exceeding the florets; lemmas

7–8 mm. long, acuminate, bifid, the awned teeth 1–2 mm. long, the awn 4–10 mm. long.

Ravines and bogs at high altitudes, Costa Rica to Peru.

CHIRIQUÍ: Volcán de Chiriquí, *Hitchcock 8219.*

14. GYNERIUM Willd.

GYNERIUM Willd. ex Beauv. Ess. Agrost. 138. *pl. 24. f. 6.* 1812.

Dioecious; staminate spikelets 2-flowered; glumes equal, 1-nerved, acute, thin and hyaline; lemmas 3-nerved, acute, glabrous, awnless; pistillate spikelets 2-flowered; first glume 1- to 3-nerved, acute, thin and hyaline, the second 3-nerved, firmer, narrower, more than twice as long as the first; rachilla glabrous, disarticulating at the base of each segment; lemmas small, attenuate to a long soft awn, villous with long white hairs.

Very large perennial with short-jointed culms, broad, flat blades and large plume-like panicles.

1. GYNERIUM SAGITTATUM (Aubl.) Beauv. Ess. Agrost. 138. *pl. 24. f. 6.* 1812.

Saccharum sagittatum Aubl. Pl. Guian. 1:50. 1775.
Gynerium saccharoides Humb. & Bonpl. Pl. Aequin. 2:105. *pl. 115.* 1813.
Arundo saccharoides Poir. in Lam. Encycl. Suppl. 4:703. 1816.

Very coarse, tall, leafy, perennial reed; culms as much as 15 m. high, with short internodes; sheaths much longer than the internodes, with a long densely villous patch on the back below the blade, also villous in the throat and on the margins near the summit, reticulate-veined, the lower ones soon falling off; blades sharply serrate, commonly 2 m. long, 4–6 cm. wide, forming a great fan-shaped summit to the sterile culms; panicles 1 m. or more long, erect, the branches drooping; pistillate spikelets: glumes very unequal, the first about 4 mm. long, the second 10–12 mm. long; body of lemma about 2 mm. long, tapering gradually into a soft delicate awn 3–4 mm. long, the hairs on the lemma exceeding the awns; staminate spikelets: glumes acute or subacuminate, the first 2–3 mm. long, the second a little broader, about 3 mm. long; lemmas 3 mm. long, acuminate, glabrous.

Swamps, river banks, and low ground, rarely on hillsides, at low altitudes, southern Mexico and the West Indies to Paraguay.

CANAL ZONE: Toro Point, *Hitchcock 8048;* Fort Sherman, *Standley 31207;* between Mindi and Colón, *Hitchcock 7946.*

15. STREPTOGYNE Beauv.

STREPTOGYNE Beauv. Ess. Agrost. 80. *pl. 16. f. 8.* 1812.

Spikelets 3- to 4-flowered, short-pedicellate in elongate one-sided racemes; glumes unequal, the second about twice as long as the first, much shorter than the florets; rachilla disarticulating above the glumes and between the floret, glabrous, narrowed and curved toward the summit, fitting into the hollow of the callus,

the articulation oblique; lemma elongate, firm, cylindrical, tapering into a slender awn, the callus extending below the point of articulation; stigmas elongate, coiled, persistent, the mature fruits hanging by these entangled stigmas.

Perennials with elongate flat blades and solitary long narrow racemes.

1. STREPTOGYNE CRINITA Beauv. Ess. Agrost. 80. *pl. 16. f. 8.* 1812.

Slender to rather coarse erect perennial; culms 70–120 cm. high, glabrous; sheaths elongate, glabrous or hirsute toward the summit, with short firm ciliate auricles extending nearly across the back; blades flat, as much as 70 cm. long, 10–22 mm. wide, long-acuminate, gradually narrowed to a long petiole-like base, smooth or scaberulous, dark green; raceme 30–50 cm. long, the spikelets appressed; glumes unequal, acuminate, the first narrow, 6–8 mm. long, the second much broader, 12–15 mm. long, sometimes awn-pointed; lemmas 20–23 mm. long, glabrous, the nerves evident only at the summit, the awn about 2 cm. long.

Wet forests at low altitudes, Mexico (Veracruz) and Trinidad to northern Brazil.

CANAL ZONE: Frijoles, *Standley 27480.* PANAMÁ: Río Indio, *Steyermark & Allen 17459.*

16. ORTHOCLADA Beauv.

ORTHOCLADA Beauv. Ess. Agrost. 69. *pl. 14. f. 9.* 1812.

Spikelets falling entire, 1- to 2-flowered, the florets distant, the second rudimentary; glumes acuminate, awnless, the first narrow, 3-nerved, the second broader, 5-nerved; lemma acuminate, awn-pointed, 5-nerved, the nerves obscure except near the summit.

Perennials with lanceolate, flat, transversely veined, petiolate blades, and large diffuse panicles, the branches spikelet bearing only near the ends.

1. ORTHOCLADA LAXA (L. Rich.) Beauv. Ess. Agrost. 70, 149, 168. 1812.

Aira laxa L. Rich. Act. Soc. Hist. Nat. Paris 1:106. 1792.
Panicum rariflorum Lam. Encycl. 4:746. 1798.
Orthoclada rariflora Beauv. Ess. Agrost. 70. *pl. 14. f. 9.* 1812.

Erect or decumbent-spreading, sparingly stoloniferous perennial; culms 60 cm. to more than 2 m. long, glabrous; sheaths rather densely pilose or sometimes nearly glabrous, usually shorter than the internodes; ligule a very short ciliate membrane; blades 5–17 cm. long, 1–3 cm. wide, acuminate, narrowed at the base to a petiole 2–3 cm. long, hispid on the upper surface, glabrous below with conspicuous cross-veins; panicle diffuse, 15–30 cm. long, about as wide, the branches rather readily disarticulating, stiffly spreading, spikelet bearing only at the ends; spikelets 6–7 mm. long; glumes subequal, acuminate, 3–4 mm. long, the first 3-nerved, the second 5-nerved, scabrous on the nerves; lemma about 6 mm. long, 5-nerved, sparsely scabrous.

Moist woods, thickets, and stream banks, Mexico to Brazil and Peru.

BOCAS DEL TORO: Laguna de Chiriquí, *Hart 71;* Old Bank Island, *von Wedel 2019,*

2167; Changuinola Valley, *Dunlap 181A, 186.* CHIRIQUÍ: Río Dupí, *Pittier 5220.* CANAL ZONE: Fort Sherman, *Standley 31108;* Las Cruces, *Pittier 2324, 2615;* Frijoles, *Maxon 4700; Pittier 2682; Killip 4285;* Barro Colorado Island, *Bailey & Bailey 86; Standley 31340;* Darién, *Standley 31639;* Obispo, *Standley 31730;* Las Cascadas, *Killip 4254; Maxon 4678;* Culebra, *Hitchcock 9209;* East Paraíso, *Standley 29923, 29974.* PANAMÁ: Río Chagres, *Dodge & Allen 17353;* Orange River, *Cornman 607;* Río Tapía, *Hitchcock 22949;* Juan Díaz, *Standley 30576;* Río Tecúmen, *Hunter & Allen 217.*

Fig. 10. *Orthoclada laxa*

17. ZEUGITES P. Br.

ZEUGITES P. Br. Civ. Nat. Hist. Jam. ed. 2. 341, and Index II. 1789.

Senites Adans. Fam. Pl. 2:39. 1763. Ineffectively published.
Despretzia Kunth, Rév. Gram. 2:485. *pl. 157*. 1831.

Spikelets few- to several-flowered, the lowest floret pistillate, the rest staminate, the rachilla joint between the perfect and staminate florets usually elongate; articulation below the glumes, the spikelets falling entire; glumes subequal, broad, obtuse or truncate, often irregularly toothed or lobed, conspicuously cross-veined; lemma of fertile floret broad, usually obtuse, the staminate florets narrower, acutish or subobtuse.

Very slender to rather coarse perennials with broad, flat, usually thin, transversely veined petiolate blades and open panicles.

a. Culms very slender, decumbent-spreading, not more than 50 cm. long; blades thin, ovate, not more than 3.5 cm. long ..... 1. Z. MEXICANA
aa. Culms coarse, erect, about 1 m. high; blades relatively thick, lanceolate, more than 10 cm., usually more than 15 cm., long ..... 2. Z. PANAMENSIS

1. ZEUGITES MEXICANA (Kunth) Trin. ex Steud. Nom. Bot. ed. 2. 2:798. 1841.

Despretzia mexicana Kunth, Rév. Gram. 2:485. *pl. 157*. 1831.
Zeugites colorata Griseb. Fl. Brit. W. Ind. 536. 1864.
Senites mexicana Hitchc. Contr. U. S. Nat. Herb. 17:370. 1913.

Very slender, decumbent-spreading perennial; culms 15–50 cm. long, wiry, usually rather freely branching, purple, shining, with a sulcus on one side; sheaths usually much shorter than the internodes, sparsely pilose or glabrous; blades 1.5–3.5 cm. long, 6–16 mm. wide, ovate, acute, thin, glabrous or very sparsely pilose, the petioles 6–10 mm. long; panicles 6–9 cm. long, the slender more or less flexuous, few-flowered branches ascending or spreading, the lower ones often reflexed; spikelets 5–6 mm. long; glumes equal, 1.5–2 mm. long, about half as long as the fertile floret; staminate florets 1 or 2, about 3 mm. long.

Rich woods at medium altitudes, southern Mexico to Bolivia.

PANAMÁ: Volcán de Chiriquí, *Hitchcock 9198*.

2. ZEUGITES **panamensis** Swallen, sp. nov.

Perennis; culmi erecti ca. 1 m. alti, pauciramosi; vaginae internodiis multo longiores, glabrae superne carinatae; ligula 1 mm. longa, membranacea, erosa; laminae 9–21 cm. longae, 2–4.8 cm. latae, late lanceolatae, acuminatae, subcordatae, glabrae, petiolis 2–20 mm. longis; paniculae 10–15 cm. longae, 10–12 cm. latae, ramis adscendentibus vel reflexis; spiculae 8–12 mm. longae, 4–6-florae, pedicellis 2–10 (–15) mm. longis; glumae aequales, 5 mm. longae, obtusae, 7-nerves, glabrae, virides vel purpurascentes; flores feminei: lemma 6 mm. longum, saccatum, obtusum vel subacutum, marginibus minute ciliolatis; flos masculus primus 5 mm. longus, lemmate subobtuso, non saccato; stamina 2 mm. longa.

Perennial; culms erect, about 1 m. high, sparingly branched; sheaths much longer than the internodes, glabrous, distinctly keeled toward the truncate sum-

Fig. 11. *Zeugites mexicana*

mit, with rather prominent cross-veins toward the margins; ligule membranaceous, somewhat erose, about 1 mm. long; blades 9–21 cm. long, 2–4.8 cm. wide, broadly lanceolate, acuminate, rounded or subcordate at the base, glabrous, conspicuously cross-veined, the petioles stout, 2–20 mm. long; panicles 10–15 cm. long, 10–12 cm. wide, the branches ascending to reflexed, the branchlets appressed, becoming divaricate with age; spikelets 8–12 mm. long, 4- to 6-flowered, the first floret pistillate, the others staminate, the pedicels 2–10 mm. long or sometimes even as much as 15 mm. long; glumes equal, 5 mm. long, obtuse (the first rarely sub-

acute), somewhat narrowed toward the base, 7-nerved, strongly cross-veined, glabrous, more or less tinged with purple; lemma of pistillate floret about 6 mm. long, saccate, obtuse, broadly acute, minutely ciliolate on the margins; palea as long as the lemma, broad, folded inward bringing the rather distant keels close together; first staminate floret about 5 mm. long, the others successively smaller, subobtuse, not saccate; stamens 2 mm. long.

PANAMÁ: hills above Campana, alt. 600–800 m., *Allen 1318* (TYPE).

Related to Z. *pittieri* Hack., which is as much as 3½ m. high with prominently viscid panicles commonly 30 cm. long, the very stiff branches arranged in fascicles; the blades are as much as 30 cm. long and 7 cm. wide, and there are 10–12 staminate florets in each spikelet. Resembling **Z. capillaris** (Hitchc.) Swallen, comb. nov. (*Senites capillaris* Hitchc.), but the panicle branches of this species are very slender, the spikelets are on long capillary pedicels, and the second glume is much smaller, scarcely, if at all, reaching the first staminate floret. **Z. hackelii** Swallen, nom. nov. (*Zeugites pittieri* var. *pringlei* Hack., not Z. *pringlei* Scribn.) differs in having usually conspicuously dentate glumes and larger blades as much as 32 cm. long and 10 cm. wide.

18. JOUVEA Fourn.

JOUVEA Fourn. Bull. Soc. Bot. Belg. 15:475. 1877.

Dioecious; staminate spikelets several to many-flowered, sessile, somewhat distant on opposite sides of the rachis, forming a terminal loose spike, the florets closely imbricate; glumes shorter than the first floret; lemmas 3-nerved, acute, awnless; pistillate spikelets in the axils of the leaves, single or in fascicles of 3 or 4, terete, somewhat curved, acuminate, consisting of 1–3 florets imbedded in the spongy tissue of the thickened rachilla, only the summit of the floret free; style and base of stigma elongate, 2-lobed.

Tough, wiry, stoloniferous perennials.

1. JOUVEA STRAMINEA Fourn. Bull. Soc. Bot. Belg. 15:475. 1877.

Tough, wiry, extensively stoloniferous perennial; culms slender, erect from a dense knotty crown, branching, 10–35 cm., rarely as much as 60 cm. high; lowermost sheaths very short, crowded, with reduced blades, the upper ones much shorter than the long internodes, glabrous, villous at the throat; blades flat or becoming involute, firm, stiffly ascending or spreading, 2–6 cm. long, 1–3 mm. wide, scabrous; staminate inflorescences 2–3 cm. long, scarcely exserted from the sheath, bearing 2–3 spikelets; spikelets 4- to 8-flowered; glumes acuminate, unequal, the first sometimes much reduced, the second 4–5 mm. long; lemmas acute or acuminate, about 4 mm. long, glabrous; anthers 2 mm. long; pistillate inflorescences 2–3 together, not crowded; spikelets 15–25 mm. long, 2- to 4-flowered, slender, pointed, arcuate.

Fig. 12. *Jouvea straminea*

Salt marshes along the coast, Mexico (Acapulco) to Panama.

PANAMÁ: abundant at Bella Vista, *Piper 5277*.

19. TRISETUM Pers.

TRISETUM Pers. Syn. Pl. 1:97. 1805.

Graphephorum Desv. Nouv. Bull. Soc. Philom. (Paris) 2:189. 1810.

Spikelets 2- to 3-flowered, the rachilla usually villous, disarticulating above the glumes and between the florets (in our species), prolonged beyond the uppermost floret; glumes somewhat unequal, acute, the second usually longer than the first floret; lemmas usually short-bearded at the base, 2-toothed at the apex, bear-

ing from the back, below the cleft apex, a straight and included or usually geniculate and exserted awn (minutely lobed and awnless or nearly so in *T. pringlei*).

Slender to tall and rather coarse perennials with flat narrow blades and open or usually narrow and rather dense panicles.

a. Culms 15–45 cm. high; lemmas awnless or nearly so, minutely lobed 1. T. PRINGLEI
aa. Culms 50–120 cm. high; lemmas awned, the awn 7–10 mm. long, geniculate.
b. Panicles silvery, almost plume-like from the copious callus hairs protruding from the glumes; glumes nearly equal in size and shape, narrow, 1-nerved 2. T. DEYEUXIOIDES
bb. Panicles greenish or purplish, not plume-like, the callus hairs short; glumes unequal, the first 1-nerved, the second broader, 3-nerved 3. T. IRAZUENSE

1. TRISETUM PRINGLEI (Scribn.) Hitchc. Proc. Biol. Soc. Washington 40:82. 1927.

Graphephorum pringlei Scribn. in Beal, Grasses N. Amer. 2:561. 1896.

Slender, densely tufted perennial; culms erect, 15–45 cm. high, glabrous; leaves mostly crowded toward the base in a dense cluster, softly and rather densely pubescent; blades firm, convolute, navicular, erect, 4–12 cm. long; panicles narrow, lax, somewhat drooping, 7–12 cm. long, the short slender scabrous branches ascending, sometimes flexuous, often naked at the base; spikelets 4–5 mm. long, 2-flowered, the florets distant, the upper one readily deciduous; glumes glabrous, unequal, the first 1.5–2 mm. long, 1-nerved, the second 3 mm. long, 3-nerved; first lemma 3.5 mm. long, 5-nerved, densely pubescent, rounded, obtusish, minutely notched, rarely with a short awn; second lemma similar but smaller; rachilla densely hairy.

Paramos at high altitudes, Mexico (Oaxaca), Costa Rica, and Panama.

CHIRIQUÍ: Volcán de Chiriquí, *Hitchcock 8222, 8228.*

2. TRISETUM DEYEUXIOIDES (H.B.K.) Kunth, Rév. Gram. 1:102. 1829.

Avena deyeuxioides H.B.K. Nov. Gen. & Sp. 1:147. 1815.
Trisetaria deyeuxioides Poir. in Lam. Encycl. Suppl. 5:366. 1817.
Avena trichopodia Presl, Rel. Haenk. 1:254. 1830.
Deyeuxia triflora Nees, Linnaea 19:691. 1847.

Slender lax perennial; culms erect or decumbent-spreading at the base, 70–120 cm. high, simple or sparingly branching; sheaths glabrous, usually longer than the internodes; ligule thin, truncate, 2–4 mm. long; blades 8–25 cm. long, 2–6 mm. wide, scabrous, sometimes pilose on the upper surface; panicles 10–25 cm. long, narrow, silvery, the short branches ascending, somewhat flexuous, spikelet bearing nearly to the base; spikelets 5–6 mm. long, 2-flowered; both glumes narrow, 1-nerved, subequal, nearly as long as the spikelet; lemmas narrowly lanceolate, glabrous, the hyaline tip bifid, the lower one 4.5–5 mm. long, the callus densely hairy, the hairs about 3 mm. long; awn 7-8 mm. long, fine, twisted below, attached about the middle; rachilla conspicuously hairy, the hairs at the summit of each segment much longer than the rest, reaching more than half the length of the lemma.

Grassy banks and thickets at medium altitudes, Mexico to Ecuador.

CHIRIQUÍ: El Boquete, *Hitchcock 8253*.

3. TRISETUM IRAZUENSE (Kuntze) Hitchc. Proc. Biol. Soc. Washington 40:82. 1927.

Trisetum gracile Fourn. Mex. Pl. 2:108. 1886. Not *T. gracile* Boiss., 1845.
Calamagrostis irazuensis Kuntze, Rev. Gen. Pl. 2:763. 1891.
Trisetum fournieranum Hitchc. Contr. U. S. Nat. Herb. 17:326. 1913.
Trisetum scabriflorum Hitchc. Contr. U. S. Nat. Herb. 24:358. 1927.

Loosely tufted, erect or somewhat decumbent perennial; culms flattened, 50–90 cm. high, glabrous; lower sheaths crowded, densely villous, the upper distant, elongate, glabrous or nearly so; ligule erose, truncate, about 1 mm. long; blades flat, mostly 8–15 cm. long, 2–4 mm. wide, sparsely pilose on both surfaces; panicles 12–20 cm. long, suberect or nodding, the branches usually ascending, somewhat flexuous, some of them naked at the base for 1–2 cm., as much as 7 cm. long; spikelets 5–8 mm. long, 2- to 3-flowered; glumes shorter than the spikelet, the first 4–5 mm. long, 1-nerved, narrow, acuminate, the second much broader, 5–6 mm. long, 3-nerved, abruptly acuminate; lemmas lanceolate, slightly toothed, 5-nerved, scabrous and minutely wrinkled on the back, the lowest one 5–6 mm. long; awn 7–10 mm. long, twisted in the lower third, inserted about one-third from the tip of the lemma.

Paramos at high altitudes, mostly above 3000 m., Mexico to Ecuador.

CHIRIQUÍ: Volcán de Chiriquí, *Hitchcock 8209, 8221, 8224; Davidson 1046; Woodson & Schery 403*.

20. AGROSTIS L.

AGROSTIS L. Sp. Pl. 61. 1753.

Vilfa Adans. Fam. Pl. 2:495. 1763.

Spikelets 1-flowered, the rachilla disarticulating above the glumes, not prolonged beyond the floret (in our species); glumes equal, longer than the floret, acute or acuminate; lemma usually obtuse, thinner than the glumes, awned from the back or awnless, glabrous or more or less hairy on the callus; palea obsolete (in our species).

Slender perennials with flat or involute blades and open panicles of small spikelets.

a. Culms 10–40 cm. high, the blades all involute, or those of the culm flat but narrow, crowded toward the base in a dense cluster; lemma 2 mm. long, the callus sparsely hairy on the sides, the awn inserted about one-fourth above the base ..... 1. A. HOFFMANNI

aa. Culms 50–60 cm. high; blades of the innovations involute-filiform, those of the culm flat, 1.5–3 mm. wide; lemma 1.5 mm. long, the callus glabrous, the awn inserted above the middle ..... 2. A. VIRESCENS

1. AGROSTIS HOFFMANNI Mez, Repert. Sp. Nov. (Fedde) 18:3. 1922.

Densely tufted perennial; culms erect, 10–40 cm. high; sheaths glabrous; ligule 2–3 mm. long, thin, hyaline; blades involute, filiform, or the upper ones sometimes

flat and 1 mm. wide, scabrous, the lower ones crowded together at the base of the plant; panicles 3–8 cm. long, narrow, dense or somewhat loose, the short branches usually appressed, not more than 2 cm. and usually less than 1 cm. long; spikelets 3 mm. long; glumes acuminate, scabrous on the keel; lemma about 2 mm. long, including the short teeth, the callus hairy on the sides; awn attached about one-fourth from the base, tightly twisted below, geniculate and protruding from the glumes, the exserted portion about 3 mm. long; palea obsolete.

Paramos and peaks of high mountains, Costa Rica and Panama.

CHIRIQUÍ: Volcán de Chiriquí, *Hitchcock 8207, 8217, 8223; Maxon 5358; Killip 4548; Pittier 3101; Davidson 1045; Woodson & Schery 425.*

2. AGROSTIS VIRESCENS H.B.K. Nov. Gen. & Sp. 1:135. 1815.

Erect tufted perennial; culms 45–60 cm. high; sheaths glabrous, longer than the internodes; ligule 3–5 mm. long, hyaline; innovation blades involute, filiform, soft, those of the culm 6–15 cm. long, 1.5–3 mm. wide, flat, scabrous; panicles 10–15 cm. long, green, the branches in rather distant verticils, as much as 6 cm. long, appressed or narrowly ascending, spikelet bearing to the base; spikelets 3 mm. long; glumes acuminate, scabrous on the keel; lemma 1.5 mm. long, the callus glabrous, the awn inserted slightly above the middle, twisted below, geniculate, protruding from the glumes, the exserted portion about 3 mm. long; palea obsolete.

Paramos at high altitudes, Mexico to Bolivia.

CHIRIQUÍ: Volcán de Chiriquí, *Pittier 3103; Woodson & Schery 415.*

21. CINNA L.

CINNA L. Sp. Pl. 5. 1753.

Abola Adans. Fam. Pl. 2:31, 511. 1763.
Cinnastrum Fourn. Mex. Pl. 2:90. 1886.

Spikelets 1-flowered, disarticulating below the glumes, falling entire; glumes equal, 1-nerved, about as long as the floret; rachilla forming a stipe below the floret, produced beyond the palea as a minute bristle; lemma similar to the glumes, 3-nerved, bearing a minute awn just below the apex; palea a little shorter than the lemma, apparently 1-keeled.

Slender to rather coarse perennials with flat blades and open, loose, drooping panicles.

1. CINNA POAEFORMIS (H.B.K.) Scribn. & Merr. U. S. Dept. Agr. Div. Agrost. Bull. 24:21. 1901.

Deyeuxia poaeformis H.B.K. Nov. Gen. & Sp. 1:146. 1815.
Poa subuniflora Kunth, Rév. Gram. 115. 1829.
Cinnastrum poaeforme Fourn. Mex. Pl. 2:91. 1886.
Cinnastrum miliaceum Fourn. Mex. Pl. 2:91. 1886.

Erect perennial; culms slender to rather coarse, 80 cm. to more than 2 m. high; sheaths glabrous, shorter than the internodes; ligule 5–15 mm. long, thin, lacerate; blades 10–30 cm. long, 5–10 mm. wide, flat, acuminate, glabrous or

scaberulous, the margins finely scabrous; panicles 15–40 cm. long, the slender drooping branches in distant verticils, naked in the lower half, some of them often as much as 15 cm. long; spikelets somewhat densely clustered, short-pedicellate, 2.5–2.8 mm. long; glumes usually very scabrous; awn of lemma obscure; rudiment slender, glabrous.

Moist thickets, forests, and banks, Mexico to Peru.

CHIRIQUÍ: Volcán de Chiriquí, *Hitchcock 8215; Killip 4547.*

22. POLYPOGON Desf.

POLYPOGON Desf. Fl. Atlant. 1:66. 1798.

Santia Savi, Mem. Soc. Ital. Modena 8^1:479. 1799.
Raspailia Presl, Rel. Haenk. 1:238. *pl. 40.* 1830.
Nowodworskya Presl, Rel. Haenk. 1:351. 1830.

Spikelets 1-flowered, disarticulating below the glumes; glumes equal, similar, awned from the tip or from between minute lobes, the awns slender, straight; rachilla not produced beyond the florets; lemma much shorter than the glumes, hyaline, with a straight slender awn, shorter than the awns of the glumes; palea present.

Somewhat coarse, erect or decumbent perennial (in our species) grasses with flat blades and narrow, often elongate, dense panicles.

1. POLYPOGON ELONGATUS H.B.K. Nov. Gen. & Sp. 1:134. 1815.

Rather coarse perennial; culms erect or usually decumbent-spreading at the base, as much as 1 m. long, glabrous; sheaths glabrous, shorter than the internodes; ligules thin, obtuse, 3–5 mm. long; blades 10–30 cm. long, 5–10 mm. wide, smooth and shining beneath, scabrous above and on the margins; panicles 10–35 cm. long, nodding, narrow and rather dense, interrupted, the branches in rather distant verticils, floriferous to the base; glumes about 3 mm. long, aristate, gradually narrowed into the awn, very scabrous; lemma 1.5 mm. long with a slender awn about 2 mm. long.

Marshes, stream banks, moist cliffs, and wet places, Mexico to Argentina.

CHIRIQUÍ: El Boquete, *Hitchcock 8232; Maxon 5234; Killip 4515;* New Switzerland, *Allen 1409.*

23. PEREILEMA Presl

PEREILEMA Presl, Rel. Haenk. 1:233. 1830.

Spikelets 1-flowered, in dense fascicles along the axis of a panicle, surrounded by numerous sterile spikelets in the form of bristles; rachilla disarticulating above the glumes, not produced beyond the floret; glumes equal, 1-nerved, thin, minutely lobed, awned from between the lobes, the awn slender, straight; lemma terete, pilose below, minutely bifid, the midnerve extending into a slender, flexuous, thread-like awn longer than the bristles; palea as long as the lemma, the keels approximate.

Annuals with narrow flat blades and dense interrupted panicles of small awned spikelets.

1. Pereilema crinitum Presl, Rel. Haenk. 1:233. *pl. 37. f. a.* 1830.

Pereilema crinitum var. *cirratum* Fourn. Mex. Pl. 2:93. 1886.

Fig. 13. *Pereilema crinitum*

Annual; culms 10–40 cm. high, erect or decumbent at the base, branching, especially at the lower nodes; sheaths much longer than the internodes, scabrous, auriculate, the auricles pubescent; ligule very short, truncate; blades 5–20 cm. long, 2–4 mm. wide, gradually tapering to a usually long, petiole-like base, scaberulous; panicles 3–12 cm., rarely 15 cm., long, narrow, dense, interrupted,

the short branches usually appressed; lemma 1.5 mm. long, scabrous, the very fine flexuous awn about 2 cm. long.

Savannas, brushy slopes, moist banks and waste places, Mexico to Ecuador.

COCLÉ: Olá, *Pittier 5046*. Without locality, *Haenke* (TYPE).

24. MUHLENBERGIA Schreb.

MUHLENBERGIA Schreb. ex Gmel. Syst. Nat. 2:171. 1791.
Dilepyrum Michx. Fl. Bor. Amer. 1:40. 1803.
Podosemum Desv. Nouv. Bull. Soc. Philom. (Paris) 2:188. 1810.
Epicampes Presl, Rel. Haenk. 1:235, *pl. 39*. 1830.

Spikelets 1-flowered, the rachilla disarticulating above the glumes; glumes very short to as long as the floret, 1-nerved, obtuse to acuminate, awnless or awned; lemma 3-nerved, usually rather firm, 3- to 5-nerved, mucronate or awned, with a short usually pilose callus; palea as long as the lemma or nearly so.

Annuals or perennials with very slender to coarse culms, flat, folded, or involute blades, and narrow, dense, or diffuse panicles of small spikelets.

a. Low delicate annuals or widely decumbent-spreading perennials.
  b. Annuals; culms 8–35 cm. high, very slender, erect or decumbent at the base.
    c. Panicles open, diffuse; lemma 1.5 mm. long; awns about 5 mm. long ..... 1. M. TENUISSIMA
    cc. Panicles narrow, the branches usually appressed, spikelet bearing to the base, the spikelets short-pedicellate; lemma 2 mm. long; awns 10–20 mm. long ..... 2. M. TENELLA
  bb. Perennials; culms as much as 1 m. long, relatively stout, widely decumbent-spreading, freely branching ..... 3. M. SETARIOIDES
aa. Coarse erect perennials, the lower sheaths conspicuously compressed-keeled.
  b. Panicles 80 cm. long, partly enclosed in the upper sheath, the branches as much as 15 cm. long, naked in the lower half; lemma glabrous or scabrous on the back near the base, the callus short-bearded; awns 3.5–4 cm. long ..... 4. M. ATTENUATA
  bb. Panicles 15–40 cm. long, exserted, the branches mostly 5–10 cm. long; lemma villous across the back near the base; awns 1–2 cm. long 5. M. EMERSLEYI

1. MUHLENBERGIA TENUISSIMA (Presl) Kunth, Rév. Gram. 1: Suppl. XVI. 1830.

Podosaemum tenuissimum Presl, Rel. Haenk. 1:230. 1830.

Delicate annual; culms very slender, 8–35 cm. long, freely branching, erect to decumbent-spreading, more or less strigose below the nodes; sheaths shorter than the internodes, glabrous; ligule hyaline, about 1 mm. long; blades 1.5–3.5 cm. long, about 0.5 mm. wide, minutely puberulent on the upper surface, with firm white margins; panicles diffuse, 2–8 cm. long, the branches mostly solitary, filiform, ascending or spreading; pedicels capillary, 3–5 mm. long, spreading, straight or flexuous; glumes acute or subobtuse, the first 0.4 mm. long, the second a little longer; lemma 1.5 mm. long, sparsely pilose, the slender awn 5 mm. long.

Dry savannas, Panama.

CANAL ZONE: Sabana of Panamá, *Pittier 2544*. PANAMÁ: Matías Hernández, *Pittier 6918;* Río Tecúmen, *Standley 29418;* Pacora River, *Killip 4214;* between Panamá and Chepo, *Dodge, Hunter, Steyermark & Allen 16687*. Without locality, *Haenke* (TYPE).

2. Muhlenbergia tenella (H.B.K.) Trin. Gram. Unifl. 192. 1824.

Podosaemum tenellum H.B.K. Nov. Gen. & Sp. 1:128. 1815.
Arundo tenella Spreng. Pl. Pugill. 2:6. 1815. Not *A. tenella* Schrad., 1806.
Trichochloa tenella Roem. & Schult. Syst. Veg. 2:385. 1817.
Muhlenbergia sprengelii Trin. Gram. Unifl. 189. 1824.
Polypogon tenellus Spreng. Syst. Veg. 1:243. 1825. Not *P. tenellus* R. Br., 1810.
Polypogon gracilis Spreng. Syst. Veg. 5:558 (Index). 1828.
Muhlenbergia exilis Fourn. Mex. Pl. 2:84. 1886.

Delicate annual; culms 8–20 cm. long, freely branching, erect or usually decumbent-spreading; sheaths pilose or nearly glabrous; ligule 0.5 mm. long; blades 1–3 cm. long, mostly less than 1 mm. wide, flat, pilose, especially on the upper surface; panicles 4–10 cm. long, the branches ascending or appressed, rather distant, solitary, closely flowered to the base, the branchlets appressed; spikelets short-pedicellate, appressed; body of glumes about 0.5 mm. long, abruptly narrowed to a short awn; lemma 2 mm. long, glabrous, the callus minutely pubescent, the awn very slender, mostly 10-20 mm. long.

Savannas, moist banks and rocky ledges, at lower altitudes, Mexico to Panama.

Chiriquí: El Boquete, *Hitchcock 8316;* road toward Dolega, *Hitchcock 8331;* Cerro Vaca, *Pittier 5308.* Coclé: Valley of Río Mata Ahogado, *Allen 137, 141;* El Valle de Antón, *Allen 2806.*

3. Muhlenbergia setarioides Fourn. Mex. Pl. 2:84. 1886.

Muhlenbergia sylvatica var. *setarioides* Beal, Grasses N. Amer. 2:249. 1896.
Muhlenbergia polypogonoides Hack. Ann. Naturhist. Hofmus. Wien 17:255. 1902.

Straggling, freely branching perennial; culms as much as 1 m. long, usually with a long decumbent or creeping rooting base, many-noded, the internodes relatively short, glabrous; sheaths longer or shorter than the internodes, glabrous or scaberulous; ligule 1–2 mm. long, thin, lacerate; blades 2–12 cm. long, 3–8 mm. wide, thin, flat, lax, scabrous; panicles 5–15 cm. long, rather dense, interrupted, the short densely flowered branches narrowly ascending or appressed; spikelets subsessile or short-pedicellate; glumes acuminate, mostly 1.5–2 mm. long, the second a little longer than the first, thin, with a prominent green midnerve; lemma 2 mm. long, acute, pilose on the lower part, scabrous above, the awn 2–10 mm. long, slender, flexuous.

Moist woods and shady banks, Mexico (Veracruz) to Panama.

Chiriquí: Río Caldera above Boquete, *Killip 4513.*

4. Muhlenbergia **attenuata** Swallen, sp. nov.

Perennis; culmi 1.8 m. alti, dense caespitosi, erecti, glabri; vaginae inferiores elongate, compressae, carinatae, scaberulae; ligula 1–2 cm. longa; laminae elongatae, attenuatae, scaberrimae; panicula 80 cm. longa, ramis gracilibus, scabris, adscendentibus, inferioribus ad 15 cm. longis, basi nudis, ramulis appressis; spiculae 2–2.5 mm. longae; glumae acutae vel subacutae lemma subequantes; lemma ca. 2.5 mm. longum, acutum, scabrum, callo breviter villoso; arista 3.5–4 cm. longa, gracilis, flexuosa.

Densely tufted perennial; culms in large clumps 1.8 m. high, erect, glabrous; lower sheaths narrow, elongate, compressed-keeled, scaberulous, the uppermost one 50 cm. long, rounded; ligule thin, lacerate, 1–2 cm. long; blades elongate, attenuate, gradually narrowed to a long fine thread-like end, very scabrous; panicle 80 cm. long, partly enclosed in the upper sheath, the long, slender, scabrous branches narrowly ascending, the lower ones as much as 15 cm. long, naked in the lower half, the branchlets appressed; spikelets 2–2.5 mm. long; glumes acute or subacute, as long as or slightly shorter than the floret, very scabrous; lemma 2.5 mm. long, acute, scabrous, the callus short, villous; awn 3.5–4 cm. long, very slender, somewhat flexuous.

Open ground, Panama.

CHIRIQUÍ: El Boquete, foothills, 1000-1300 m. alt., *Hitchcock 8174* (U. S. Nat. Herb., TYPE).

5. MUHLENBERGIA EMERSLEYI Vasey, Contr. U. S. Nat. Herb. 3:66. 1892.
Muhlenbergia vaseyana Scribn. Rep. Mo. Bot. Gard. 10:52. 1899.
Epicampes emersleyi Hitchc. Bull. U. S. Dept. Agr. 772:144. 1920.
Epicampes subpatens Hitchc. Bull. U. S. Dept. Agr. 772:144. 1920.

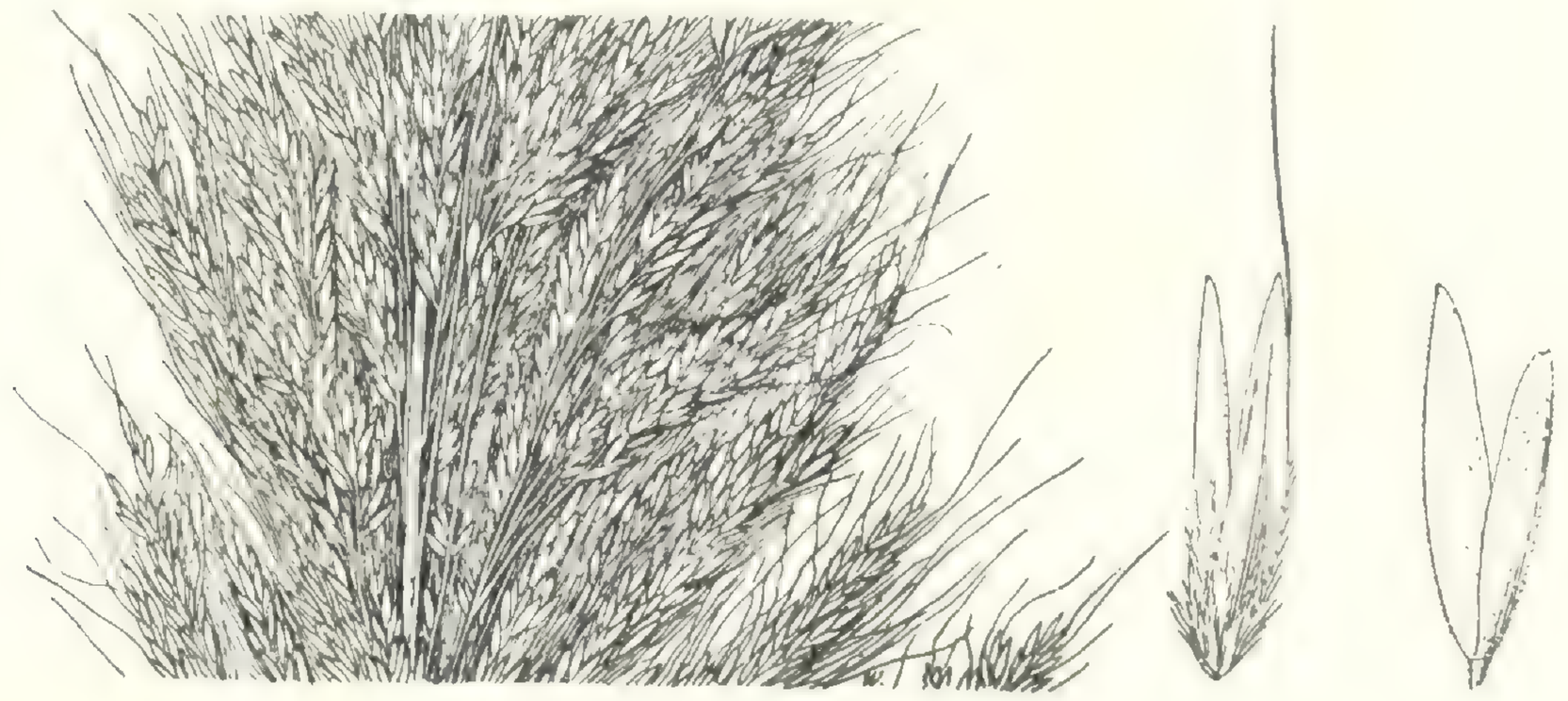

Fig. 14. *Muhlenbergia emersleyi*

Densely tufted perennial; culms erect, 0.5–1 m. high, glabrous; sheaths flattened and keeled, glabrous, the lower ones elongate, all longer than the internodes; ligule thin, lacerate, 1–2 cm. long; blades elongate, conduplicate at the base, 2–4 mm. wide, scabrous, especially on the margins; panicles 15–40 cm. long, narrow, dense, but rather loose, erect, the narrowly ascending branches 5–10 cm. long, naked below for a short distance, or spikelet bearing nearly to the base; spikelets 2–2.5 mm. long; glumes equal, as long as or a little shorter than the floret, acute, scabrous; lemma scabrous above, villous across the back near the base, the awn mostly 1–2 cm. long.

Dry savannas and open grassy hillsides, southwestern United States to Panama.

CHIRIQUÍ: El Boquete, *Hitchcock 8174, 8241, 8242;* Cerro Vaca, *Pittier 5360;* road toward Dolega, *Hitchcock 8340.* COCLÉ: Olá, *Pittier 5042, 5062;* El Valle de Antón, *Allen 2812.*

25. SPOROBOLUS R. Br.

Sporobolus R. Br. Prodr. Fl. Nov. Holl. 169. 1810.

Agrosticula Raddi, Agrost. Bras. 33. 1823.
Bennetia Raf. Bull. Bot. Seringe 1:220. 1830.
Cryptostachys Steud. Syn. Pl. Glum. 1:181. 1854.
Bauchea Fourn. Mex. Pl. 2:87. 1886.

Spikelets 1-flowered, disarticulating above the glumes; glumes awnless, subequal or usually unequal, the second often as long as the spikelet; lemma 1-nerved, acute to obtuse, awnless; palea as long as or sometimes longer than the lemma.

Annuals or perennials with open or contracted, often spike-like, panicles of small spikelets.

a. Plants annual; panicles narrow, dense, purplish ..... 1. S. ciliatus
aa. Plants perennial; panicles open, or if dense, green, not purple.
  b. Culms wiry, creeping, with hard scaly rhizomes. Seacoast plants .. 5. S. virginicus
  bb. Culms cespitose, erect, without rhizomes.
    c. Panicles narrow but open, the branches verticillate, spreading to reflexed; lower sheaths densely ciliate on the margins with long hairs ..... 2. S. cubensis
    cc. Panicles dense and spike-like or somewhat open but the branches ascending or appressed, not verticillate; lower sheaths glabrous on the margins.
      d. Panicles dense and spike-like; spikelets 2–2.4 mm. long; glumes unequal, the first 0.5 mm. long, the second 0.7–1 mm. long ..... 3. S. poiretii
      dd. Panicles scarcely dense, the slender branches ascending to spreading; spikelets 1.6–1.8 mm. long; glumes subequal, 0.3–0.5 mm. long ..... 4. S. indicus

1. Sporobolus ciliatus Presl, Rel. Haenk. 1:242. 1830.

Vilfa ciliata Trin. Mém. Acad. St. Pétersb. VI. Sci. Nat. 4^1:63. 1840. Not *Vilfa ciliata* Beauv. 1812.
Vilfa preslii Steud. Nom. Bot. ed. 2. 2:768. 1841.

Low annual; culms erect or decumbent at the base, 4–35 cm. high; sheaths mostly longer than the internodes, glabrous or sparsely papillose-hispid, ciliate on the margins; blades 2.5–10 cm. long, 3–5 mm. wide, flat, acuminate, the margins prominently papillose-ciliate, more or less papillose-pilose or papillose-hispid on both surfaces; panicles 2–12 cm. long, narrow, dense, purplish, the short slender branches appressed, floriferous to the base, sparsely covered with small glands; spikelets 1.6–1.8 mm. long; glumes acute, the first 0.5 mm. long, the second nearly as long as the spikelet; lemma similar but slightly longer than the second glume.

Savannas and grassy slopes at low altitudes, Honduras to Brazil.

chiriquí: David, *Hitchcock 8355, 8376;* San Felix, *Pittier 5195.* coclé: Aguadulce, *Pittier 4865;* El Valle de Antón, *Allen 2807.* canal zone: Corozal, *Killip 4188; Hitchcock 9203.* panamá: Las Sabanas, *Standley 25908;* Hacienda La Joya, *Dodge, Hunter, Steyermark & Allen 16879;* Panamá, *Standley 26886, 27732; Hitchcock 8405;* Bella Vista, *Killip 12033;* Juan Díaz, *Killip 4133.* Without locality, *Haenke* (type).

2. Sporobolus cubensis Hitchc. Contr. U. S. Nat. Herb. 12:237. 1909.

Densely tufted perennial; culms erect, 30–60 cm. high; lower sheaths crowded, becoming reddish-brown with age, conspicuously and densely ciliate with long

Fig. 15. *Sporobolus ciliatus*

hairs on the margins, the culm sheaths shorter than the internodes, glabrous; blades flat or folded, 10-30 cm. long, 2–4 mm. wide, tapering toward the base, narrower than the mouth of the sheath, papillose or papillose-ciliate on the margins toward the base; panicles mostly 8–12 cm. long, open, the short branches verticillate, spreading to reflexed, bearing 1–3 spikelets; spikelets 3–4 mm. long; first glume narrow, acuminate, about half as long as the spikelet, the second much broader, acute, as long as the lemma.

Dry savannas and rocky slopes at low altitudes, southern Mexico and the West Indies to Venezuela and British Guiana.

CANAL ZONE: Frijoles, *Killip 4344.*

3. Sporobolus poiretii (Roem. & Schult.) Hitchc., Bartonia 14:32. 1932.

Sporobolus elongatus Lam. Tabl. Encycl. 1:162. 1791. Not *S. elongatus* R. Br. 1810.
Agrostis compressa Poir. in Lam. Encycl. Suppl. 1:258. 1810. Not *A. compressa* Willd., 1790, nor Poir (op. cit.) 1:259. 1810.
Axonopus poiretii Roem. & Schult. Syst. Veg. 2:318. 1817.
Agrostis tenuissima Spreng. Syst. Veg. 1:258. 1825.
Sporobolus lamarckii Desv. ex Hamilt. Prodr. Pl. Ind. Occ. 4. 1825.
Vilfa exilis Trin. Mém. Acad. St. Pétersb. VI. Sci. Nat. 4^1:89. 1840.
Vilfa berteroana Trin. Mém. Acad. St. Pétersb. VI. Sci. Nat. 4^1:100. 1840.
Sporobolus angustus Buckl. Proc. Acad. Phila. 1862:88. 1862.
Vilfa tenacissima var. *exilis* Fourn. Mex. Pl. 2:99. 1886.
Vilfa tenacissima var. *intermedia* Fourn. Mex. Pl. 2:99. 1886.
Vilfa tenacissima var. *robusta* Fourn. Mex. Pl. 2:100. 1886.
Sporobolus littoralis var. *elongatus* Dur. & Schinz, Consp. Fl. Afr. 5:821. 1894.
Sporobolus berteroanus Hitchc. & Chase, Contr. U. S. Nat. Herb. 18:370. 1917.

Erect, tufted, glabrous perennial; culms 1–1.5 m. high; leaves mostly crowded toward the base; blades flat, elongate, attenuate, often flexuous toward the ends, mostly 3–5 mm. wide; panicles 20–35 cm. long, plumbeous, dense, the branches appressed, floriferous to the base or nearly so; spikelets 2–2.4 mm. long; glumes obtuse, the first 0.5 mm. long, the second 0.7–1 mm. long.

Open ground and waste places, tropical and subtropical America. Introduced from Asia.

chiriquí: El Boquete, *Hitchcock 8248, 8288;* Finca Lérida to Boquete, *Woodson, Allen & Seibert 1160.* colón: Colón, *Hitchcock 8035.*

4. Sporobolus indicus (L.) R. Br. Prodr. Fl. Nov. Holl. 170. 1810.

Agrostis indica L. Sp. Pl. 63. 1753.
Sporobolus jacquemontii Kunth, Rév. Gram. 2:427. *pl. 127.* 1831.

Perennial; culms slender, in large dense clumps about 1 m. high; blades narrow, elongate, attenuate to a fine point, usually flexuous, flat or becoming loosely rolled; panicles 15–30 cm. long, attenuate toward the tip, the slender branches ascending or spreading; spikelets 1.6–1.8 mm. long, short-pedicellate, subsecund on the under side of the branches; glumes subequal, obtuse, 0.3–0.5 mm. long.

Savannas, dry hills, fields and waste places, Mexico and the West Indies to Colombia and Brazil.

canal zone: Toro Point, *Hitchcock 8041;* Gatún, *Hitchcock 7979;* Barro Colorado Island, *Kenoyer 129; Bailey & Bailey 629;* Culebra, *Hitchcock 7911; Pittier 3434, 3439, 4064;* Summit, *Standley 26917, 29687;* Pedro Miguel, *Hitchcock 7954;* Corozal, *Bro. Gervais 161; Pittier 6732;* Ancón Hill, *Standley 26316;* Balboa, *Hitchcock 8021.* panamá: Taboga Island, *Hitchcock 8066;* Panamá, *Standley 27694.* colon: Colón, *Rose 22062; Piper 5217, 5225.*

5. Sporobolus virginicus (L.) Kunth, Rév. Gram. 1:67. 1829.

Agrostis virginica L. Sp. Pl. 63. 1753.
Agrostis littoralis Lam. Tabl. Encycl. 1:161. 1791.
Vilfa littoralis Beauv. Ess. Agrost. 16, 147, 181. 1812.
Vilfa virginica Beauv. Ess. Agrost. 16, 182. 1812.
Crypsis virginica Nutt. Gen. Pl. 1:49. 1818.
Podosaemum virginicum Link, Hort. Berol. 1:85. 1827.
Sporobolus littoralis Kunth, Rév. Gram. 1:68. 1829.

Extensively creeping, tough, wiry perennial with hard scaly rhizomes; culms slender to rather stout, 50–70 cm., or even as much as 1 m., long, with short internodes; sheaths glabrous; blades conspicuously distichous, mostly 8–12 cm. long, 3–5 mm. wide at the base, very firm, becoming loosely rolled or involute, gradually narrowed to a rather fine but firm point; panicles densely spike-like, 6–10 cm. long, 0.5–1 cm. thick, usually partly enclosed in the sheath; spikelets 2.5 mm. long, rarely longer; glumes acute, subequal, the second as long as the spikelet, the first a little shorter.

Salt marshes and sandy seacoasts, southern Florida, and the West Indies to Brazil and Chile.

CANAL ZONE: Toro Point, *Hitchcock 8037;* Fort Sherman, *Standley 31181;* Cristóbal, *Pittier 4233.* COLÓN: Colón, *Hitchcock 8036.*

26. ARISTIDA L.

ARISTIDA L. Sp. Pl. 82. 1753.

Chaetaria Beauv. Ess. Agrost. 30, *pl. 8, f. 5, 6.* 1812.
Ortachne Nees, in Seem. Bot. Voy. Herald, 225. 1854.

Spikelets 1-flowered, disarticulating above the glumes; glumes usually unequal, 1-nerved, or rarely 3- to 5-nerved, acuminate or awned; lemma indurate at maturity, terete, convolute around the palea, glabrous or scabrous toward the tip with a sharp, entire or minutely bifid, bearded callus; awns 3, the lateral sometimes very short or wanting, sometimes united at the base in a slender twisted column.

Densely tufted annuals or perennials with involute or narrow flat blades and open or contracted, occasionally spike-like panicles.

a. Lateral awns wanting or very much reduced.
  b. Plants annual; culms freely branching; panicles narrow, the short branches spikelet-bearing to the base; central awn curved or flexuous, the lateral ones wanting ..... 1. A. JORULLENSIS
  bb. Plants perennial; culms simple; panicles open, diffuse, the long branches naked below; central awn straight or arcuate, the lateral ones very much reduced ..... 2. A. TERNIPES
aa. Lateral awns well developed, nearly as long as the central one.
  b. Plants annual; culms very slender, 5–25 cm. high ..... 3. A. CAPILLACEA
  bb. Plants perennial; culms stouter.
    c. Awns twisted below into a slender column.
      d. Callus minutely bifid; culms 20–40 cm. high ..... 4. A. PLANIFOLIA
      dd. Callus entire; culms 50 cm. to more than 1 m. high.
        e. Panicles dense, interrupted; lemma 3.5–4 mm. long, much shorter than the glumes; awns 10–12 mm. long, loosely coiled below ..... 5. A. RECURVATA
        ee. Panicles narrow but loose; lemma 8–12 mm. long, about as long as the glumes; awns 1–2.5 cm. long, divergent, not coiled 6. A. ORIZABENSIS
    cc. Awns not twisted; panicles 5–10 cm. long, dense, spike-like..... 7. A. TINCTA

1. ARISTIDA JORULLENSIS Kunth, Rév. Gram. 1:62. 1829.

Streptachne pilosa H.B.K. Nov. Gen. & Sp. 1:124. 1815. Not *Aristida pilosa* Labill., 1824.
Ortachne pilosa Nees, in Seem. Bot. Voy. Herald, 225. 1854.
Aristida manzanilloana Vasey; Contr. U. S. Nat. Herb. 1:282. 1893.

Erect annual in small tufts; culms 10–45 cm. high, rarely more, slender, freely

branching from all the nodes; blades mostly less than 10 cm. long, 1–2 mm. wide, flat or becoming involute, tapering to a fine point, scabrous on the upper surface and bearing scattered long white hairs; panicles 5–20 cm. long, finally long-exserted, the short, stiff, rather distant, ascending to spreading branches floriferous to the base, bearing scattered long fine hairs; glumes narrow, acuminate, subequal, 5–7 mm. long, glabrous; lemma gradually narrowed into a curved or flexuous awn, the lemma and awn together 15–35 mm. long, the division indistinct, the lateral awns wanting.

Dry savannas, hillsides, fields, and open ground, Mexico to Panama.

CHIRIQUÍ: Davíd, *Hitchcock 8354.* COCLÉ: Aguadulce, *Pittier 4850.* CANAL ZONE: between Fort Clayton and Corozal, *Standley 29154;* between Panamá and Corozal, *Hitchcock 9202;* Ancón Hill, *Standley 25210; Killip 4194.* PANAMÁ: Point Chamé, *Hitchcock 8157;* Chorrera, *Hitchcock 8170;* Las Sabanas, *Standley 25832, 31858;* Panamá, *Hitchcock 8408; Standley 26799; Piper 5246;* Punta Paitilla, *Standley 26266;* Abalaba, *Killip 4269;* Río Tapia, *Hitchcock 22947;* Río Tecúmen, *Standley 26635, 29396;* between Panamá and Chepo, *Dodge, Hunter, Steyermark & Allen 16695;* Chepo, *Pittier 4642, 4753.*

2. ARISTIDA TERNIPES Cav. Icon. Pl. 5:46. 1799.

Streptachne scabra H.B.K. Nov. Gen. & Sp. 1:124. *pl. 40.* 1815.
Streptachne tenuis H.B.K. Nov. Gen. & Sp. 1:124. 1815.
Aristida scabra Kunth, Rév. Gram. 1:62. 1829.
Aristida tenuis Kunth, Rév. Gram. 1:62. 1829.
Muhlenbergia scabra Trin. & Rupr. Mém. Acad. St. Pétersb. VI. Sci. Nat. 5^1:183. 1842.
Streptachne cubensis A. Rich. in Sagra, Hist. Cuba 11:311. 1850.
Ortachne scabra Fourn. Bull. Soc. Bot. France 27:295. 1880.
Ortachne tenuis Fourn. Bull. Soc. Bot. France 27:295. 1880.

Perennial; culms in small tufts, erect, 50–150 cm. high; blades flat, elongate, flexuous, involute toward the tip, tapering into a fine point; panicles large, diffuse, drooping, one-third to half the length of culm, the branches relatively stout, scabrous, naked below; spikelets appressed toward the ends of the branches; glumes 8–10 mm. long; lemma 15–18 mm. long, including the flattened and tapering summit, scabrous on the keel, the central awn subterete, straight or arcuate, 10–15 mm. long, the lateral awns usually less than 1 mm. long.

Rocky hills and open, usually dry places, Texas and Arizona to Colombia; Cuba, Bahamas.

CANAL ZONE: Balboa, *Standley 25269, 26406.* PANAMÁ: Panamá, *Hitchcock 8402; D. H. Popenoe 61.* Without locality, *Luis Née* (TYPE).

3. ARISTIDA CAPILLACEA Lam. Tabl. Encycl. 1:156. 1791.

Aristida elegans Rudge, Pl. Guian. 22. *pl. 30.* 1805.
Chaetaria capillacea Beauv. Ess. Agrost. 30, 158. *pl. 8. f. 6.* 1812.
Chaetaria capillaris Nees, Agrost. Bras. 388. 1829.

Delicate annual; culms 5–25 cm. high, erect, freely branching; blades 1–5 cm. long, less than 1 mm. wide, scabrous on the margins, often sparsely pilose with long white hairs; panicles 2–8 cm. long, usually tinged with purple, the capillary branches ascending or spreading, more or less flexuous, naked below, not more than 2 cm. long; glumes narrow, acuminate, the first 2–2.5 mm. long, the second 2.5–3

mm. long, sometimes subequal; lemma 2 mm. long, tapering into a slender twisted column 1.5–2 mm. long; awns about 5 mm. long, divergent.

Dry fields and savannas, Mexico to Brazil and Bolivia.

CHIRIQUÍ: San Felix, *Pittier 5194;* Sabana de la Tortuga, *Pittier 3315;* Bajo Boquete, *Killip 4588.* COCLÉ: El Valle de Antón, *Allen 2805.* CANAL ZONE: between Panamá and Corozal, *Hitchcock 9197.* PANAMÁ: Orange River, *Killip 4259; Cornman 606;* Panamá, *Standley 27731, 29751;* Río Tapia, *Hitchcock 22946; Standley 28188;* Pacora, *Killip 4203;* Río Tecúmen, *Standley 26497;* Chepo, *Hunter & Allen 79.*

4. ARISTIDA **planifolia** Swallen, sp. nov.

Perennis; culmi 20–40 cm. alti, dense caespitosi, erecti, glabri; vaginae glabrae internodiis longiores, breviter auriculatae; ligula 0.1-0.2 mm. longa, minute ciliata; laminae 8–30 cm. longae, 1–3 mm. latae, involutae, infra scabrae, supra dense pubescentes; paniculae 10–15 cm. longae, erectae, densae, ramis brevibus, appressis, ad basin floriferis; glumae acuminatae, aristatae, in carina scabrae, prima 15 mm. longa, secunda 20–25 mm. longa; lemma 6–7 mm. longum, rostro arcte torto 15–25 mm. longo, callo bifido dense pubescente, 1–1.5 mm. longo; aristae rigidae, scabrae, divergentes, 20–40 mm. longae, basi planae.

Perennial; culms 20–40 cm. high, densely tufted, erect, glabrous; sheaths glabrous, longer than the internodes, slightly auriculate; ligule 0.1–0.2 mm. long, very minutely ciliate; blades 8–30 cm. long, 1–3 mm. wide, involute, the lower ones becoming flat and curled at the base of the plant with age, with rather broad thickened scabrous margins, glabrous on the lower surface, densely but minutely pubescent on the upper; panicles 10–15 cm. long, erect, dense, the short branches closely appressed, floriferous to the base; glumes narrow, acuminate, scabrous on the keel, awned, the first 15 mm. long, the second 20–25 mm. long, including the awns; lemma 6–7 mm. long, the slender twisted beak 15–25 mm. long, the densely pubescent bifid callus 1–1.5 mm. long; awns stiff, about equally divergent, 20-40 mm. long, scabrous, somewhat flattened at the base, the central a little longer than the lateral ones.

Closely related to *A. riparia* Trin., but differing primarily in the short panicle and flat blades coiled at the base of the plant.

Savannas, Panama and Colombia.

PANAMÁ: CHIRIQUÍ: Cerro Vaca, alt. 900–1136 m., Dec. 25-28, 1911, *Pittier 4350* (U. S. Nat. Herb., TYPE). COLOMBIA: TOLIMA: *Woronow 7030.*

5. ARISTIDA RECURVATA H.B.K. Nov. Gen. & Sp. 1:123. 1815.

Chaetaria recurvata Roem. & Schult. Syst. Veg. 2:397. 1817.
Aristida neesiana Trin. & Rupr. Mém. Acad. St. Pétersb. VI. Sci. Nat. 5^1:113. 1842.
Aristida riedeliana Trin. & Rupr. Mém. Acad. St. Pétersb. VI. Sci. Nat. 5^1:114. 1842.

Densely tufted perennial with numerous old blades flattened and coiled at the base of the plants; culms 60–100 cm. high, relatively slender, glabrous, or scabrous below the panicle; sheaths longer than the internodes, glabrous; blades 15–30 cm. long, 1–3 mm. wide, tapering to a long involute point, glabrous beneath, scaberulous above, with thickened scabrous margins; panicles 10–30 cm. long, narrow,

dense, somewhat interrupted, the branches ascending or appressed, rebranching from near the base, the branchlets appressed and dense, giving the panicle a lobed appearance, the lower internodes as much as 3 cm. long, the upper ones gradually shortened; glumes 8–10 mm. long, narrow, acuminate or awn-pointed, the first very scabrous; lemma 3.5–4 mm. long, glabrous, the slender slightly twisted column 2–3 mm. long, the callus blunt, densely pubescent, about 0.4 mm. long; awns 10–12 mm., rarely 15 mm., long, the central slightly longer than the lateral ones, all loosely coiled together at the base, divergent.

Savannas and dry, rocky or grassy slopes, British Honduras; Panama to Colombia and Brazil.

CANAL ZONE: Ancón Hill, *Killip 4220; Piper 5267; Standley 26347;* between Panamá and Corozal, *Hitchcock 9194.* PANAMÁ: Hacienda La Joya, *Dodge, Hunter, Steyermark & Allen 16893.*

6. ARISTIDA ORIZABENSIS Fourn. Mex. Pl. 2:78. 1886.

Aristida pseudospadicea F. T. Hubb. Proc. Amer. Acad. 49:500. 1913.

Perennial; culms slender, 50 cm. to more than 1 m. high, smaller in depauperate plants, glabrous; blades 10–30 cm. long, 1–3 mm. wide, scabrous on the upper surface, flat at the base, becoming involute-pointed, the older ones at the base of the plant finally flattened and coiled; panicles 15–30 cm. long, the branches distant, the upper ones appressed, the lower ones often spreading, somewhat flexuous, usually less than 8 cm. long; spikelets appressed; glumes 8–10 mm. long, narrow, acuminate, awn-pointed, the second a little longer than the first; lemma 8–12 mm. long with a slender twisted beak about 3 mm. long; awns 1–2.5 cm. long, about equally divergent, the central a little longer than the lateral ones.

Savannas, thickets, and rocky hills, Mexico to Panama.

COCLÉ: Olá, *Pittier 5047, 5066;* between Paso del Arado and Olá, *Pittier 5019.*

7. ARISTIDA TINCTA Trin. & Rupr. Mém. Acad. St. Pétersb. VI. Sci. Nat. 5^1:111. 1842. (Separate)

Chaetaria spadicea Nees, Agrost. Bras. 385. 1829. Not *Aristida spadicea* H.B.K., 1815.
Aristida breviglumis Mez, Repert. Sp. Nov. (Fedde) 17:152. 1921.

Wiry, densely tufted, erect perennial; culms 40–75 cm. high; blades usually erect, elongate, flat, 1–3 mm. wide with slender involute tips, scabrous on the upper surface and on the margins, the lower ones sometimes curved or flexuous; panicles 5–10 cm. long, narrow, rather dense, interrupted, usually tinged with purple, the short branches ascending or appressed, floriferous to the base; glumes about equal, 6 mm. long, acuminate, awn-pointed; lemma 5 mm. long, the short blunt callus minutely pubescent, the summit somewhat narrowed, straight; awns slender, spreading, more or less curved or flexuous, the central 15–20 mm. long, the lateral 10–12 mm. long.

Dry hillsides and savannas, Costa Rica to Brazil.

CANAL ZONE: Ancón Hill, *Killip 4197.* PANAMÁ: Río Azote Caballo, *Dodge, Steyermark & Allen 16853.*

27. ANTHEPHORA Schreb.

ANTHEPHORA Schreb. Beschr. Gräs. 2:105. *pl. 44.* 1810.

Spikelets 1-flowered, in groups of 4, the first glumes many-nerved, indurate, thickened and united at the base forming a false pitcher-shaped involucre around the rest of the spikelets, the groups short-pedicellate, falling entire; second glume 5-nerved, narrowed to a blunt tip; lemma ovate-acuminate, 3-nerved, firm but not indurate, the broad flat margins curved around and enclosing the palea.

Weedy annuals, in our species, with flat blades and terminal spike-like racemes.

1. ANTHEPHORA HERMAPHRODITA (L.) Kuntze, Rev. Gen. Pl. 2:759. 1891.

Tripsacum hermaphrodita L. Syst. Nat. ed. 10. 2:1261. 1759.
Anthephora elegans Schreb. Beschr. Gräs. 2:105. *pl. 44.* 1810.
Anthephora villosa Spreng. Neu. Entd. 3:14. 1822.
Cenchrus villosus Spreng. Syst. Veg. 1:301. 1825.

Annual; culms erect or decumbent at the base, branching, rooting at the lower nodes, 15–50 cm. high; sheaths glabrous or papillose-hirsute near the summit; ligule 2–3 mm. long, thin, brownish; blades 5–20 cm. long, 3–8 mm. wide, flat, acuminate, scabrous; racemes 5–10 cm. long, erect; first glumes 5–7 mm. long, broad, acute or acuminate, scabrous.

Open sandy ground and waste places, tropical America.

COLÓN: Palenque, *Pittier 4125.* CANAL ZONE: Frijoles, *Killip 4304;* Gamboa, *Pittier 3762;* Ancón, *Piper 5234.* PANAMÁ: Taboga Island, *Killip 4146.*

28. LEPTOCHLOA Beauv.

LEPTOCHLOA Beauv. Ess. Agrost. 71, 166. *pl. 15. f. 1.* 1812.

Diplachne Beauv. Ess. Agrost. 80. *pl. 16. f. 9.* 1812.
Rabdochloa Beauv. Ess. Agrost. 84. 1812.
Leptostachys G. Meyer, Prim. Fl. Esseq. 73. 1818.
Oxydenia Nutt. Gen. Pl. 1:76. 1818.
Diachroa Nutt. Trans. Amer. Phil. Soc. II. 5:147. 1837.
Ipnum R. A. Phil. Anal. Univ. Chile 36:211. 1870.

Spikelets few- to several-flowered, the upper floret reduced to a small awnless rudiment, sessile or short-pedicellate, crowded or somewhat distant on one side of the slender rachis; glumes 1-nerved, the second usually longer and broader than the first; lemmas 3-nerved, acute, minutely bifid, awnless or rarely short-awned, pubescent or pilose on the margins and sometimes on the internerves.

Annual or perennial grasses with flat blades and numerous slender spikes scattered along the common axis.

a. Plants annual; sheaths sparsely papillose-pilose; lemmas 1–1.5 mm. long. 1. L. FILIFORMIS
aa. Plants perennial; sheaths glabrous or nearly so; lemmas 1.5–2 mm. long. 2. L. VIRGATA

1. LEPTOCHLOA FILIFORMIS (Lam.) Beauv. Ess. Agrost. 71, 161, 166. 1812.

Festuca filiformis Lam. Tabl. Encycl. 1:191. 1791.
Eleusine mucronata Michx. Fl. Bor. Amer. 1:65. 1803.
Eleusine filiformis Pers. Syn. Pl. 1:87. 1805.
Oxydenia attenuata Nutt. Gen. Pl. 1:76. 1818.

Leptostachys filiformis G. Meyer, Prim. Fl. Esseq. 74. 1818.
Leptochloa mucronata Kunth, Rév. Gram. 1:91. 1829.
Leptochloa brachiata Steud. Syn. Pl. Glum. 1:209. 1854.
Leptochloa attenuata Steud. Syn. Pl. Glum. 1:209. 1854.
Leptochloa pellucidula Steud. Syn. Pl. Glum. 1:209. 1854.
Leptochloa paniculata Fourn. Bull. Soc. Bot. France II. 27:296. 1880.
Leptochloa mucronata pulchella Scribn. Bull. Torrey Club 9:147. 1882.
Leptochloa pilosa Scribn. U. S. Dept. Agr. Div. Agrost. Circ. 32:9. 1901.

Annual; culms slender to rather coarse, branching, erect or sometimes geniculate at the lower nodes, 10 cm. to more than 1 m. high; sheaths sparsely papillose-pilose with long hairs, rarely glabrous; ligule membranaceous, 1-2 mm. long; blades 5–30 cm. long, 3–10 mm. wide, flat, lax, glabrous or sparsely papillose-pilose; inflorescence nearly half the length of the culm; spikes several to numerous, racemose on an elongated axis, spreading or reflexed, 2–15 cm. long (usually less than 10 cm.); spikelets 2- to 3-flowered, 1.5–2 mm. long, the upper floret scarcely exceeding the glumes; glumes acuminate, subequal; lemmas 1–1.5 mm. long, obtuse, minutely bilobed, awnless, pubescent on the nerves and sometimes on the internerves.

A weed in cultivated fields and waste ground, southeastern United States to Argentina.

CANAL ZONE: Ancón, *Killip 4182;* Balboa, *Standley 26416.* PANAMÁ: Matías Hernández, *Pittier 6855, 6903;* Panamá, *Hitchcock 8406;* Taboga Island, *Standley 27958; Hitchcock 8081; Pittier 3564.*

2. LEPTOCHLOA VIRGATA (L.) Beauv. Ess. Agrost. 71, 161, 166. *pl. 15, f. 1.* 1812.

Cynosurus virgatus L. Syst. Nat. ed. 10. 2:876. 1759.
Festuca virgata Lam. Tabl. Encycl. 1:189. 1791.
Eleusine virgata Pers. Syn. Pl. 1:87. 1805.
Chloris poaeformis H.B.K. Nov. Gen. & Sp. 1:169. 1816.
Chloris digitaria H.B.K. Nov. Gen. & Sp. 1:168. 1816.
Leptostachys digitaria G. Meyer, Prim. Fl. Esseq. 74. 1818.
Leptostachys virgata G. Meyer, Prim. Fl. Esseq. 74. 1818.
Leptochloa procera Nees, Syll. Pl. Ratisb. 1:2. 1824.
Cynodon virgatus Raspail, Ann. Sci. Nat. Bot. 5:302. 1825.
Leptochloa digitaria Nees, Agrost. Bras. 433. 1829.
Leptochloa procera var. *major* Brongn. in Duperrey, Bot. Voy. Coquille 2^2:48. 1830.
Leptochloa procera var. *minor* Brongn. in Duperrey, Bot. Voy. Coquille 2^2:48. 1830.
Leptochloa mutica Steud. Syn. Pl. Glum. 1:208. 1854.
Leptochloa virgata var. *aristata* Fourn. Mex. Pl. 2:146. 1886.
Leptochloa virgata var. *intermedia* Fourn. Mex. Pl. 2:146. 1886.
Leptochloa perennis Hack. Inf. Est. Centr. Agron. Cuba 1:411. 1906.

Perennial; culms tufted, erect or somewhat decumbent at the base, 30 cm. to more than 1 m. high; sheaths rounded, glabrous or nearly so; ligule 0.2–0.3 mm. long, minutely erose; blades 10–20 cm. long, 4–12 mm. wide, flat, acuminate, the margins scabrous; inflorescence drooping, 10–15 cm. long; spikes somewhat aggregate, slender, drooping, mostly 6–10 cm. long; spikelets 3- to 4-flowered, 2–3 mm. long; glumes similar, acute, the first 1.5 mm. long, the second a little longer; lemmas 1.5–2 mm. long, sparsely pilose on the margins, the tip blunt, often minutely lobed, awnless or rarely awned.

Open ground along streams and ditches, also in brushy places, Texas, Florida, and the West Indies to Argentina.

BOCAS DEL TORO: Laguna de Chiriquí, *Hart 67, 76;* Lincoln Creek, *Carleton 190.* CHIRIQUÍ: David, *Hitchcock 8356.* COLÓN: Palenque, *Pittier 4136.* CANAL ZONE: Toro Point, *Hitchcock 8039;* Fort Sherman, *Standley 30926;* Río Pequení, *Woodson, Allen & Seibert 1629;* Gatuncillo, *Piper 5273;* Frijoles, *Standley 31486;* Barro Colorado Island, *Kenoyer 131;* Gamboa, *Standley 28529;* Culebra, *Hitchcock 7918; Pittier 2081, 3440;* Corozal, *Killip 4250; Piper 5263;* Ancón, *Killip 4105;* Balboa, *Standley 25251, 26459.* PANAMÁ: Sambú River, *Pittier 5527;* Taboga Island, *Standley 27959.*

29. ELEUSINE Gaertn.

ELEUSINE Gaertn. Fruct. & Sem. 1:6. *pl. 1. f. 11.* 1788.

Spikelets few- to several-flowered, compressed, sessile in two rows on one side of a rather broad rachis; rachilla disarticulating above the glumes and between the florets; glumes shorter than the first floret, unequal, the first 1-nerved, the second 3- to 5-nerved, the lateral nerves approximate close to the keel; lemmas acute, 3-nerved, the nerves close together, the uppermost somewhat reduced; seed dark brown, roughened by fine ridges, loosely enclosed in the thin pericarp.

Annual grasses with two to several racemes digitate at the summit of the culms, sometimes with one or two a short distance below.

1. ELEUSINE INDICA (L.) Gaertn. Fruct. & Sem. 1:8. 1788.

Cynosurus indicus L. Sp. Pl. 72. 1753.
Eleusine gracilis Salisb. Prodr. Stirp. 19. 1796.
Eleusine domingensis Sieber ex Schult. Mant. 2:323. 1824. Not *E. domingensis* Pers., 1805.
Cynodon indicus Raspail, Ann. Sci. Nat. Bot. 5:303. 1825.
Eleusine scabra Fourn. ex Hemsl. Biol. Centr. Amer. Bot. 3:565. 1885, name only; Fourn. Mex. Pl. 2:145. 1886.
Eleusine indica var. *major* Fourn. Mex. Pl. 2:145. 1886.

Culms in tough spreading clumps, somewhat decumbent at the base, 15–70 cm., or rarely as much as 1 m., high, compressed, very smooth; sheaths compressed, sharply keeled, sparsely papillose near the margins toward the summit, otherwise glabrous, the margins hyaline; ligule membranaceous, erose, about 1 mm. long; blades as much as 25 cm. long, 2–8 mm. wide, flat or conduplicate, the tip navicular, glabrous or sparsely pilose on the upper surface, the margins scabrous; spikes 2 to several, 5–10 cm. long, stiffly ascending; spikelets 5 mm. long; lemmas 3 mm. long, broad at the base, rather abruptly narrowed to the subacute apex, sometimes mucronate.

BOCAS DEL TORO: Laguna de Chiriquí, *Hart 93; von Wedel 1526.* CHIRIQUÍ: David, *Killip 4504;* El Boquete, *Hitchcock 8180.* COCLÉ: Aguadulce, *Pittier 4973.* COLÓN: Porto Bello, *Pittier 2479;* Colón, *Rose 22083.* CANAL ZONE: Frijoles, *Pittier 3760;* Culebra, *Hitchcock 7910; Pittier 2114;* Summit, *Standley 30078;* Ancón, *Bro. Celestine 78;* Balboa, *Standley 26403.* PANAMÁ: Chepo, *Pittier 4694;* Taboga Island, *Hitchcock 8075.*

30. DACTYLOCTENIUM Willd.

DACTYLOCTENIUM Willd. Enum. Pl. 1029. 1809.

Spikelets 3- to 5-flowered, compressed, sessile and closely imbricate in two rows on one side of the rather narrow flat rachis, the rachis extending beyond the spikelets; rachilla disarticulating above the first glume and between the florets; glumes broad, unequal, 1-nerved, the second mucronate or short-awned below the tip, deciduous; lemmas broad, keeled, 3-nerved, acuminate or short-awned, the lateral nerves indistinct; palea about as long as the lemma; seed subglobose, ridged, enclosed in a thin pericarp.

Annual grasses with flat blades and 2 to several, short, thick, digitate, ascending or spreading spikes, the rachis prolonged beyond the spikelets.

1. DACTYLOCTENIUM AEGYPTIUM (L.) Aschers. & Schweinf. Illustr. Fl. Aegypte. Mém. Inst. Égypt. 2:171. 1887.

Cynosurus aegyptius L. Sp. Pl. 72. 1753.
Aegilops saccharinum Walt. Fl. Carol. 249. 1788.
Eleusine aegyptiaca Desf. Fl. Atlant. 1:85. 1798.
Eleusine pectinata Moench, Meth. Pl. Suppl. 68. 1802.
Chloris mucronata Michx. Fl. Bor. Amer. 1:59. 1803.
Eleusine aegyptia Pers. Syn. Pl. 1:87. 1805.
Dactyloctenium aegyptiacum Willd. Enum. Pl. 1029. 1809.
Dactyloctenium mucronatum Willd. Enum. Pl. 1029. 1809.
Eleusine mucronata Stokes, Bot. Mat. Med. 1:150. 1812.
Rabdochloa mucronata Beauv. Ess. Agrost. 84, 158, 176. 1812.
Eleusine cruciata Ell. Bot. S. C. & Ga. 1:176. 1816.
Dactyloctenium meridionale Hamilt. Prodr. Pl. Ind. Occ. 6. 1825.
Dactyloctenium mucronatum var. *erectum* Fourn. Mex. Pl. 2:144. 1886.

Culms branching, radiate-spreading, rooting at the nodes, the ascending ends mostly 20–40 cm. long; spikes 2–5, 1–3 cm. long, thick, digitate, the rachis produced beyond the spikelets in a stiff point; spikelets pectinate, crowded, about 3 mm. long; first glume 1.5 mm. long, acute, scabrous on the keel; second glume a little longer than the first with an awn 1–2.5 mm. long; lemmas acute or acuminate, 2.5–3.5 mm. long.

Fields and waste places in tropical and warm temperate regions around the world.

COCLÉ: Aguadulce, *Pittier 4972.* CANAL ZONE: Chagres, *Fendler 367;* Gatún, *Standley 27264;* Bella Vista, *Killip 4043;* Empire, *Pittier 3717;* Culebra, *Hitchcock 7901; Pittier 2598;* Corozal, *Pittier 6729.* PANAMÁ: Matías Hernández, *Pittier 6758;* Gorgona Beach, *Woodson, Allen & Seibert 1695;* Panamá, *Standley 27688;* Chepo, *Pittier 4461;* Taboga Island, *Hitchcock 8074.*

31. CYNODON L.

CYNODON L. Rich. ex. Pers. Syn. Pl. 1:85. 1805. (Conserved).
Capriola Adans. Fam. Pl. 2:31, 532. 1763.
Fibichia Koel. Descr. Gram. 308. 1802.

Spikelets 1-flowered, sessile in two rows on one side of the narrow triangular rachis, the rachilla disarticulating above the glumes, prolonged beyond the spikelet in a naked stipe, sometimes bearing a rudimentary floret; glumes subequal, acuminate, 1-nerved, the first lunate, the second lanceolate; lemma acute, awnless, 3-nerved, pubescent on the nerves; palea narrow, acute, as long as the lemma.

Stoloniferous perennials with short blades and few to several slender digitate spikes.

1. CYNODON DACTYLON (L.) Pers. Syn. Pl. 1:85. 1805.

Panicum dactylon L. Sp. Pl. 58. 1753.
Digitaria dactylon Scop. Fl. Carn. ed. 2. 1:52. 1772.
Dactilon officinale Vill. Hist. Pl. Dauph. 2:69. 1787.
Paspalum dactylon Lam. Tabl. Encycl. 1:176. 1791.
Digitaria littoralis Salisb. Prodr. Stirp. 19. 1796.
Milium dactylon Moench, Meth. Pl. Suppl. 67. 1802.
Fibichia umbellata Koel. Descr. Gram. 308. 1802.
Digitaria stolonifera Schrad. Fl. Germ. 1:165. 1806.
Cynodon maritimus H.B.K. Nov. Gen. & Sp. 1:170. 1816.
Cynodon tenuis Trin. in Spreng. Neu. Entd. 2:63. 1821.
Chloris cynodon Trin. Gram. Unifl. 229. 1824.
Digitaria maritima Spreng. Syst. Veg. 1:272. 1825.
Cynodon erectus Presl, Rel. Haenk. 1:290. 1830.
Capriola dactylon Kuntze, Rev. Gen. Pl. 2:764. 1891.
Fibichia dactylon Beck, Wiss. Mitt. Bosn. Herzeg. 9:436. 1904.
Cynodon dactylon var. *maritimus* Hack. in Fries, Arkiv Bot. 8:40. 1909.
Capriola dactylon maritima Hitchc. U. S. Dept. Agr. Bull. 772:179. 1920.

Rhizomatous, stoloniferous, widely creeping perennial; culms wiry, compressed, 10–40 cm. high; sheaths usually overlapping, keeled, glabrous or sparsely pilose at the throat; ligule membranaceous, minutely erose, 0.2–0.3 mm. long; blades flat, 2–20 cm. long (usually 5–10 cm.), 2–4 mm. wide, scabrous, especially on the margins, sometimes sparsely pilose; spikes 4–7, slender, arcuate, 2–7 cm. long; spikelets 2–3 mm. long.

A common weed in open ground throughout the warmer regions of the world.

CANAL ZONE: between Mindi and Colón, *Hitchcock 7947;* Victoria Fill, *Allen 1753;* Culebra, *Hitchcock 7923;* Mamei Hill, *Pittier 3813;* Summit, *Standley 30087;* between Corozal and Ancón, *Pittier 2166;* Balboa, *Standley 27408.*

32. CTENIUM Panzer

CTENIUM Panzer, Denkschr. Baier. Akad. Wiss. München 4:288. *pl. 13.* 1813. (Conserved).

Campulosus Desv. Nouv. Bull. Soc. Philom. (Paris) 2:189. 1810.
Monocera Ell. Bot. S. C. & Ga. 1:176. 1816.
Monathera Raf. Amer. Month. Mag. 4:190. 1819.

Spikelets several-flowered, sessile in two rows on one side of a flattened rachis, the rachilla disarticulating above the glumes, the first two florets sterile, the third fertile, the upper ones remote, much smaller, staminate or neuter; first glume short, acute, 1-nerved; second glume acute or subacuminate, 2- to 3-nerved, the nerves approximate, the lateral ones usually with a conspicuous row of glands, the central nerve excurrent from the middle of the back in a stout or rather slender divergent awn; florets bearded on the callus; lemmas acute or acuminate, sometimes minutely toothed, 3-nerved, the margins variously ciliate, awned from the back or from between the teeth, the awn of the second sterile lemma usually much longer

than the others; palea subacute or subobtuse, as long as the lemma, narrow, the nerves sometimes excurrent in short awns.

Erect, tufted perennials with tall slender culms, firm flat narrow blades, and usually solitary, arcuate or flexuous spikes.

1. CTENIUM CONCISSUM Swallen, N. Amer. Fl. 17:601. 1939.

Perennial; culms erect, 35-100 cm. high, pubescent below the spike; sheaths longer than the internodes, scaberulous, the lower ones becoming shredded with age; ligule membranaceous, 1 mm. long, truncate; blades as much as 30 cm. long, 2–4 mm. wide, flat or becoming subinvolute, acuminate, scaberulous; spike 5–16 cm. long, arcuate or becoming flexuous, the rachis 1.5 mm. wide, scabrous on the back, pubescent on the margins; first glume acute, 2 mm. long; second glume acuminate, 8–9 mm. long, scabrous, the awn slender, ascending or spreading, 3–5 mm. long, scaberulous; first sterile lemma 3 mm. long, glabrous on the back, the margins long-ciliate almost the entire length, the awn straight, 4 mm. long; second sterile lemma 4.5–5 mm. long, glabrous on the back, the margins long-ciliate on the upper half, the awn 10–15 mm. long, flexuous; fertile lemma 4–5 mm. long, the margins ciliate on the upper half, the cilia about 3 mm. long, the awn straight, 3 mm. long; palea of the fertile floret subobtuse, scabrous on the keels, the nerves sometimes excurrent in short awns; reduced upper floret 3 mm. long, with an awn about 1 mm. long.

Savannas, Coclé and Chiriquí provinces, Panama.

CHIRIQUÍ: Cerro Vaca, *Pittier 4349*. COCLÉ: Picacho de Olá, *Pittier 5065* (TYPE).

33. GYMNOPOGON Beauv.

GYMNOPOGON Beauv. Ess. Agrost. 41, *pl. 9. f. 3*. 1812.

Anthopogon Nutt. Gen. Pl. 1:81. 1818.
Biatherium Desv. Opusc. 72. 1831.
Monochaete Doell in Mart. Fl. Bras. 2^3:78. 1878.
Doellochloa Kuntze, Rev. Gen. Pl. 2:773. 1891.

Spikelets 1- to 3-flowered, articulated above the glumes, subsessile in two rows on one side of the slender rachis, the rachilla prolonged beyond the upper floret, often bearing a very rudimentary floret, this sometimes reduced to awns; glumes narrow, acuminate, 1-nerved, nearly equal, longer than the florets; lemmas narrow, 3-nerved, awned from between the teeth of a minutely bifid apex, or sometimes almost awnless.

Perennial grasses with erect stiff culms, rounded sheaths, firm, flat or loosely rolled, stiffly spreading blades, and few to numerous slender spikes scattered along the upper half or third, or crowded at the summit of the culm.

1. GYMNOPOGON FASTIGIATUS Nees, Agrost. Bras. 430. 1829.

Monochaete fastigiata Doell in Mart. Fl. Bras. 2^3:79. 1878.
Doellochloa fastigiata Kuntze, Rev. Gen. Pl. 2:773. 1891.

Perennial; culms very slender, erect or spreading, 30–60 cm. high; sheaths usually much shorter than the internodes, glabrous or sparsely pilose at the mouth; ligule ciliate, 0.1 mm. long; blades flat or rolled, firm, stiffly ascending or sometimes spreading, 1–3 cm. long, 1–3 mm. wide, the margins scabrous; spikes 4–8, 2–7 cm. long, slender, ascending, on an axis 1–4 cm. long; spikelets 1-flowered, the rachilla prolonged behind the floret, the rudimentary floret wanting; glumes acuminate, about 3 mm. long; lemma 2 mm. long, the callus glabrous, the margins long-ciliate toward the summit, the awn very slender, about 1 cm. long.

Savannas and open woods, Costa Rica and Panama; also in Brazil.

COCLÉ: Olá, *Pittier 5055*.

34. CHLORIS Swartz

CHLORIS Swartz, Prodr. Veg. Ind. Occ. 25. 1788.
Eustachys Desv. Nouv. Bull. Soc. Philom. (Paris) 2:188. 1810.
Schultesia Spreng. Pl. Pugill. 2:17. 1815.
Agrostomia Cervant. Naturaleza 1:345. 1870.

Spikelets subsessile in two rows on one side of the rachis, with one perfect floret, the rachilla articulate above the glumes, prolonged beyond the fertile floret, and bearing a narrow or club-shaped rudiment composed of one or more reduced sterile lemmas; glumes narrow, 1-nerved (rarely 3-nerved), the second a little longer than the first; fertile lemma 3-nerved, awned from the back just below the usually acute tip, the callus more or less bearded on the sides, the keel glabrous or sparsely pilose, the margins usually ciliate, the hairs on the upper part often much longer than the rest.

Annual or perennial, often stoloniferous grasses, with 2 to several digitate, verticillate, or subracemose spikes.

a. Florets dark brown ..... 1. C. PETRAEA
aa. Florets green or pale, sometimes tinged with purple.
  b. Plants annual; rudiment broad, truncate, conspicuous.
    c. Fertile lemma 3–3.5 mm. long, the cilia as much as 4 mm. long; rudiment composed of one reduced floret ..... 2. C. VIRGATA
    cc. Fertile lemma not more than 2.5 mm. long, the cilia 1–2 mm. long; rudiment composed of two reduced florets ..... 3. C. INFLATA
  bb. Plants perennial; rudiment narrow, acute, usually inconspicuous ..... 4. C. RADIATA

1. CHLORIS PETRAEA Swartz, Prodr. Veg. Ind. Occ. 25. 1788.

Agrostis complanata Ait. Hort. Kew. 1:96. 1789.
Eustachys petraea Desv. Nouv. Bull. Soc. Philom. (Paris) 2:189. 1810.
Schultesia petraea Spreng. Pl. Pugill. 2:17. 1815.
Chloris swartzii C. Muell. Bot. Zeit. 19:341. 1861.
Chloris septentrionalis C. Muell. Bot. Zeit. 19:340. 1861.
Chloris swartziana Doell in Mart. Fl. Bras. 2^3:68. 1878.

Perennial; culms erect or sometimes decumbent at the base and rooting at the lower nodes, 30 cm. to more than 1 m. high, conspicuously flattened; sheaths broad, flattened and keeled, crowded at the base in a fan-shaped cluster; ligule very short, minutely ciliate; blades conduplicate at the base, becoming flat toward the obtuse tip, 4–20 cm. (mostly about 10 cm.) long, 4–8 mm. wide, glabrous or densely

pubescent on the upper surface at the very base; spikes 2–7 (usually 4–6), 3–12 cm. (mostly 6–8 cm.) long, digitate, narrowly ascending; spikelets 2 mm. long, horizontally spreading; glumes 1-nerved, scabrous on the keel, the first 1.2 mm. long, acute, crescent-shaped, the second a little longer, broader, obtuse, notched, with an awn 0.5–1 mm. long; fertile floret dark brown, 1.8 mm. long, the callus very short and rounded, the lemma obovate, blunt, pubescent on the keel, sparsely short-hispid on the upper half of the margins, the tip scabrous, the internerves smooth and shining, mucronate; rudiment oblong-truncate, about 1 mm. long, 0.5 mm. wide, the tip scabrous.

Open sandy ground, usually near the coast, southeastern United States, eastern Mexico, and the West Indies to Trinidad and Panama.

COLÓN: between Fató and Playa de Damas, *Pittier 3944;* Palenque, *Pittier 4133, 4135.*
CANAL ZONE: Toro Point, *Hitchcock 8040;* Fort Sherman, *Standley 31193; Piper 5883.*

2. CHLORIS VIRGATA Swartz, Fl. Ind. Occ. 203. 1797.

Chloris pubescens Lag. Var. Cienc. 4:143. 1805.
Rabdochloa virgata Beauv. Ess. Agrost. 84, 158. 1812.
Chloris compressa DC. Cat. Hort. Monsp. 94. 1813.
Chloris elegans H.B.K. Nov. Gen. & Sp. 1:166. *pl. 49.* 1816.
Chloris alba Presl, Rel. Haenk. 1:289. 1830.
Chloris alba var. *aristulata* Torr. U. S. Rep. Expl. Miss. Pacif. 4:155. 1857.
Agrostomia barbata Cervant. Naturaleza 1:346. 1870.

Annual; culms erect, or usually decumbent at the base, sometimes rooting at the lower nodes, 10 cm. to more than 1 m. high; sheaths compressed-keeled, glabrous, mostly longer than the internodes; ligule very short, minutely ciliate; blades flat, 4–25 cm. long, 3–7 mm. wide, scaberulous or nearly smooth on both surfaces, sometimes more or less papillose-pilose on the upper surface near the base, the margins scabrous; spikes 3–15 (usually about 6), 3–9 cm. (usually 5–6 cm.) long, erect or narrowly ascending, flexuous, crowded in a rather dense silvery head; spikelets 3–3.5 mm. long; glumes acuminate, 1-nerved, scabrous on the keel, the first 1.5–2.5 mm. long, the second 2.5–3 mm. long, with an awn about 1 mm. long; fertile floret 3–3.5 mm. long, the callus bearded, the lemma acute, the keel bowed out at the middle, short-ciliate on the margins on the lower part, long-ciliate on the upper third, the hairs as much as 4 mm. long, the awn rather stout, 6–10 mm. long, scabrous; rudiment 2–2.5 mm. long, about 0.7 mm. wide, subacute, the awn 5–7 mm. long.

A weed in fields and waste places, central and southwestern United States, Mexico, and the West Indies; also in South America and the Old World.

CANAL ZONE: Barro Colorado Island, *Kenoyer 119;* Balboa, *Standley 25623.*

3. CHLORIS INFLATA Link, Enum. Pl. 1:105. 1821.

Andropogon barbatum L. Mant. Pl. 2:302. 1771.
Chloris barbata Swartz, Fl. Ind. Occ. 200. 1797.
Chloris paraguayensis Steud. Syn. Pl. Glum. 1:204. 1854.

Annual; culms erect, or decumbent at the base and rooting at the lower nodes, 15–85 cm. high; sheaths compressed-keeled, glabrous, the margins hyaline; ligule

0.3 mm. long, minutely ciliate; blades flat, 5–10 cm. long (rarely to 25 cm. long), 2–3 mm. wide, glabrous, or sparsely hispid near the base, the margins scabrous; spikes 7–10, 3–8 cm. long, digitate, more or less flexuous, erect or nearly so, forming a rather dense purplish head; spikelets 2.3–2.5 mm. long; glumes 1-nerved,

Fig. 16. *Chloris radiata*

purple, with hyaline margins, sparsely scabrous on the keel, the first acuminate, 1.5–1.7 mm. long, the second abruptly acute, submucronate, 2.2–2.3 mm. long; fertile floret 2.4 mm. long, the callus prominently bearded, the lemma subobtuse, pilose on both sides of the midnerve, the margins conspicuously ciliate on the upper half, the hairs 1–2 mm. long, the awn 6–8 mm. long; rudiment composed of two reduced, club-shaped, spreading florets, 1–1.5 mm. long, the awns mostly 6–8 mm. long.

Waste places, Mexico and the West Indies, and southward to Argentina.

COLÓN: Colón, *Rose 22063*. CANAL ZONE: Gatún, *Standley 27326;* Monte Lirio, *Maxon 6851;* Darién, *Standley 31620;* Gamboa, *Standley 28341;* Empire, *Pittier 3721;* Culebra, *Hitchcock 7924; Pittier 2120;* Corozal, *Pittier 2617;* Ancón, *Piper 5255; Bro. Celestine 22.* PANAMÁ: Bella Vista, *Standley 25381.*

4. CHLORIS RADIATA (L.) Swartz, Prodr. Veg. Ind. Occ. 26. 1788.

Agrostis radiata L. Syst. Nat. ed. 10. 2:873. 1759.
Cynosurus scoparius Lam. Encycl. 2:188. 1786.
Chloris gracilis Durand, Chlor. Sp. 10. 1808.
Chloris durandiana Schult. Mant. 2:341. 1824.
Chloris glaucescens Steud. Syn. Pl. Glum. 1:206. 1854.
Gymnopogon radiata Parodi, Physis 4:180. 1918.

Perennial; culms erect or decumbent at the base, branching, 15–60 cm. high, distinctly flattened; sheaths compressed-keeled, longer than the internodes, glabrous; blades thin, flat, mostly 4-10 cm. long, or the lower ones sometimes longer, smooth or scabrous, sometimes sparsely pilose; ligule 0.5 mm. long, minutely ciliate; spikes 5–15 (mostly more than 10), 4–8 cm. long, slender, straight or flexuous, subdigitate or in 2 or 3 approximate fascicles, ascending or spreading; spikelets appressed; glumes acuminate, 1-nerved, the first 1–2 mm. long, the second 2–3 mm. long, glabrous, or scabrous on the keel; fertile floret about 2.5–3 mm. long, narrow, the callus bearded, the lemma glabrous on the back, short-ciliate on the upper part of the margins, the awn 5–10 mm. long, scaberulous; rudiment very slender, 1 mm. long, glabrous, the awn 4–6 mm. long, scaberulous.

Roadsides, grassy plains, and waste places, Mexico and the West Indies to Bolivia and Argentina.

BOCAS DEL TORO: Laguna de Chiriquí, *Hart 66.* CHIRIQUÍ: David, *Hitchcock 8380.* CANAL ZONE: Toro Point, *Hitchcock 8053;* Gatún, *Standley 27318;* Frijoles, *Killip 4296;* Barro Colorado Island, *Standley 41125;* Obispo, *Standley 31788;* Gamboa, *Standley 28350;* Culebra, *Hitchcock 7894;* Summit, *Standley 30082;* Balboa, *Standley 25584, 26461.* PANAMÁ: Taboga Island, *Hitchcock 8073.*

35. BOUTELOUA Lag.

BOUTELOUA Lag. Var. Cienc. 4:134. 1805.

Atheropogon Muhl. ex Willd. Sp. Pl. 4:937. 1806.
Triathera Desv. Nouv. Bull. Soc. Philom. (Paris) 2:188. 1810.
Heterosteca Desv. Nouv. Bull. Soc. Philom. (Paris) 2:188. 1810.
Chondrosium Desv. Nouv. Bull. Soc. Philom. (Paris) 2:188. 1810.
Polyodon H.B.K. Nov. Gen. & Sp. 1:174. 1816.
Triaena H.B.K. Nov. Gen. & Sp. 1:178. 1816.

Actinochloa Willd. ex Roem. & Schult. Syst. Veg. 2:22, 417. 1817.
Eutriana Trin. Fund. Agrost. 161. 1820.
Erucaria Cervant. Naturaleza 1:347. 1870.

Spikelets few- to several-flowered, with one fertile floret and one or two rudimentary florets above it, the second floret often staminate and sometimes perfect; glumes 1-nerved, the first narrow, the second much broader, twice as long as the first, or both broad, similar and subequal; fertile lemma 3-nerved, glabrous or bearded at the base, glabrous or pilose on the margins and sometimes pilose across the back, the tip variously lobed or dentate, the nerves usually excurrent in short awns; rudiment reduced to 3 awns or glumaceous, lobed or dentate with 3 usually conspicuous awns.

Perennial (in our species), usually tufted grasses with slender culms and few to many short 1-sided spikes, racemose on a short or often elongated axis.

a. Plants annual; spikes 10–25. Sheaths and blades sparsely to densely papillose-pilose or papillose-hispid or the sheaths rarely glabrous ..... 1. B. DISTICHA
aa. Plants perennial; spikes 4–10.
  b. Glumes 3–5 mm. long, glabrous or scabrous on the keel; culms widely spreading. Spikes linear, 1–4 cm. long ..... 2. B. AMERICANA
  bb. Glumes 5–9 mm. long, usually hispid on the keel; culms erect or ascending.
    c. Lemma of the upper floret deeply cleft ..... 3. B. REPENS
    cc. Lemma of the upper floret minutely dentate ..... 4. B. FILIFORMIS

1. BOUTELOUA DISTICHA (H.B.K.) Benth. Jour. Linn. Soc. Bot. 19:105. 1881.

Polyodon distichum H.B.K. Nov. Gen. & Sp. 1:175. 1816.
Eutriana polyodon Trin. Gram. Unifl. 242. 1824.
Atheropogon distichus Spreng. Syst. Veg. 1:294. 1825.
Eutriana pilosa Hook. f. Trans. Linn. Soc. 20:173. 1847.
Eutriana gracilis Hook. f. Trans. Linn. Soc. 20:175. 1847.
Bouteloua pilosa Benth. ex S. Wats. Proc. Amer. Acad. 18:179. 1883.
Eutriana mucronata Areschoug, Svensk Freg. Eugenies Resa, 118. 1910.

Annual; culms slender, branching, usually decumbent-spreading; sheaths glabrous or usually papillose-pilose, especially toward the summit, the collar often densely pubescent; ligule ciliate, about 0.5 mm. long; blades flat, acuminate, 5–20 cm. long, 2–7 mm. wide, scabrous and more or less papillose-pilose; spikes 10–25, 5–8 mm. long, usually spreading, falling entire; glumes acuminate, scabrous, the first 3–5 mm. long, the second 5–8 mm. long; fertile lemma 5–6 mm. long, 3-toothed, the teeth aristate, the central one minutely bifid; rudiment small, usually reduced to an awn scarcely longer than the fertile floret.

Open or brushy places, Guatemala and the West Indies south to Peru; Galapagos Islands.

COCLÉ: Aguadulce, *Pittier 4996*. CANAL ZONE: Ancón, *D. H. Popenoe 28; Hitchcock 22943; Piper 5275*; Balboa, *Standley 26422*. PANAMÁ: Las Sabanas, *Standley 25843*; Panamá, *Standley 26775*; Río Tecúmen, *Standley 29393*; Sabana of Panamá, *Pittier 2537*; Pacora River, *Killip 4215*.

2. BOUTELOUA AMERICANA (L.) Scribn. Proc. Acad. Phila. 1891:306. 1891.

Aristida americana L. Syst. Nat. ed. 10. 2:879. 1759.
Aristida antillarum Poir. in Lam. Encycl. Suppl. 1:451. 1810.
Bouteloua litigiosa Lag. Gen. & Sp. Nov. 5. 1816.

Chaetaria antillarum Beauv. ex Roem. & Schult. Syst. Veg. 2:395. 1817.
Atheropogon antillarum Spreng. Syst. Veg. 1:294. 1825.
Aristida subbiflora Steud. Syn. Pl. Glum. 1:138. 1854.
Eutriana antillarum Steud. Syn. Pl. Glum. 1:217. 1854.
Bouteloua elatior Griseb. Fl. Brit. W. Ind. 537. 1864.
Atheropogon americanus Fourn. Mex. Pl. 2:139. 1886.
Aristida adscensionis var. *americana* Kuntze, Rev. Gen. 3^3:340. 1898.

Perennial; culms rather slender, branching, decumbent, sometimes prostrate-spreading, 30–60 cm. high; sheaths glabrous, much shorter than the internodes; ligule very short, ciliate; blades 5–20 cm. long, 1–3 mm. wide, the margins scabrous and papillose or papillose-pilose; spikes 4–10, 1–4 cm. long, linear, ascending or spreading; glumes acuminate, the first 3–4 mm. long, the second slightly broader, 4–5 mm. long, glabrous; fertile floret 4–5 mm. long, the lemma acuminate, glabrous, the callus densely hairy on the sides, the central awn terminal, 2–3 mm. long, the lateral ones about 1.5 mm. long; rudiment reduced to 3 scabrous awns, 8–10 mm. long.

Dry rocky hills, open ground and waste places, Honduras and the West Indies to Brazil.

CANAL ZONE: Ancón Hill, *Killip 4217*. PANAMÁ: Panamá, *Hitchcock 8409*; Las Sabanas, *Standley 25844; Killip 4035;* Bella Vista, *Standley 25360*.

3. Bouteloua repens (H.B.K.) Scribn. & Merr. U. S. Dept. Agr. Div. Agrost. Bull. 24:26. 1901.

Dinebra repens H.B.K. Nov. Gen. & Sp. 1:172. 1816.
(?) Bouteloua bromoides Lag. Gen. & Sp. Nov. 5. 1816.
Atheropogon repens Roem. & Schult. Syst. Veg. 2:416. 1817.
(?) Actinochloa bromoides Roem. & Schult. Syst. Veg. 2:420. 1817.
Eutriana repens Trin. Gram. Unifl. 241. 1824.

Perennial; culms 20–50 cm. high, erect or ascending, branching; sheaths glabrous or sparsely papillose-pilose; ligule minutely ciliate, 0.5 mm. long; blades firm, flat, 8–15 cm. long, 2–5 mm. wide, glabrous or scabrous, sometimes more or less papillose or papillose-pilose; spikes 5–10, 1.5–2.5 cm. long, rather close together, appressed or spreading, falling entire; glumes acuminate, subequal, about 7 mm. long, scabrous or hispid on the keel; lemma of fertile floret 8 mm. long, the central awn 2–4 mm. long, the lateral 1.5–2 mm. long; rudiment glabrous, about 6 mm. long, deeply cleft, the awn from between the lobes 8–10 mm. long, the lateral awns much more slender and a little shorter than the central one.

Sandy soil and rocky slopes near the coast, western Mexico to Panama.

COCLÉ: Aguadulce, *Pittier 4873*. CANAL ZONE: Las Cruces Trail, *Standley 29155*. PANAMÁ: Panamá, *Piper 5276;* Las Sabanas, *Pittier 6865; Standley 25864*.

4. Bouteloua filiformis (Fourn.) Griffiths, Contr. U. S. Nat. Herb. 14:413. 1912.

Atheropogon filiformis Fourn. Mex. Pl. 2:140. 1886.

Perennial; culms in small dense tufts, simple or branching, erect or decumbent-spreading at the base, 15–50 cm. high, glabrous; sheaths glabrous or sparsely pilose;

blades flat, acuminate, mostly 5–10 cm. long, 1–2 mm. wide, glabrous or sparsely pilose, the margins scabrous, usually more or less papillose-ciliate; ligule ciliate, less than 1 mm. long; spikes 5–10, ascending or spreading, mostly 1–2 cm. long, falling entire, the rachis short-ciliate, densely pubescent at the base; glumes acuminate, subequal or the second a little longer, mostly 5–7 mm. long, glabrous, the keel scabrous to hispid; lemma about 7 mm. long, glabrous or bearded at the base, acuminate, the awns about 1 mm. long, scabrous; upper floret usually staminate, sometimes perfect, glabrous or bearded at the base, the lemma minutely bifid, the central awn thickish, 3–8 mm. long, the lateral ones more slender, a little shorter than the central.

Rocky hills, southwestern United States to Panama.

PANAMÁ: San Carlos, *Allen 1148*.

36. AEGOPOGON Humb. & Bonpl.

AEGOPOGON Humb. & Bonpl. ex Willd. Sp. Pl. 4:899. 1806.

Spikelets in groups of 3, the groups pedunculate, spreading, falling entire, arranged alternately on opposite sides of a slender flattened axis, the central spikelet fertile, the lateral ones staminate or neuter; spikelets 2-flowered; glumes equal, 1-nerved, notched at the apex, awned from between the lobes; lemmas 3-nerved, longer than the glumes, the nerves extending into awns.

Slender perennials with short, narrow flat blades and small racemes, the groups of spikelets all turned to one side.

1. AEGOPOGON CENCHROIDES Humb. & Bonpl. ex Willd. Sp. Pl. 4:899. 1806.

Slender, spreading perennial; culms 20–50 cm. long, erect, or the longer ones spreading, freely branching; sheaths glabrous, keeled; ligule hyaline, 1–2 mm. long, obtuse; blades 2–6 cm. long, 1–2 mm. wide, flat, acuminate, scabrous; racemes slender, 2–5 cm. long, usually purple; spikelets about 3 mm. long, the central awn of the first floret about 10 mm. long, the others half as long or less.

Dry rocky savannas and slopes at medium altitudes, Mexico to Bolivia.

CHIRIQUÍ: Volcán de Chiriquí, *Hitchcock 8206, 8218, 8229; Maxon 5358a; Killip 4551; Pittier 3097; Woodson & Schery 426;* El Boquete, *Hitchcock 8236, 8249; Killip 4514; Davidson 731, 905;* Bajo Boquete, *Killip 4557*.

37. ORYZA L.

ORYZA L. Sp. Pl. 333. 1753.

Spikelets 1-flowered, disarticulating below the glumes, laterally compressed; glumes narrow, much shorter than the lemma (in our species); lemma indurate, rigid, keeled, 3-nerved, awned or sometimes awnless, sparsely to rather densely hispid; palea similar to the lemma but narrower and with no midnerve on the back, the two nerves close to the margins.

Annuals or perennials with flat blades and open or contracted panicles.

a. Plants annual, cultivated, sometimes escaped ..... 1. O. SATIVA
aa. Plants perennial, native.
b. Spikelets 8–9 mm. long; awns 5–10 cm. long; panicles narrow; blades 7–14 mm. wide ..... 2. O. PERENNIS
bb. Spikelets 5 mm. long; awns 1–2 cm. long; panicles large and open; blades 1–3.5 cm. wide ..... 3. O. LATIFOLIA

1. ORYZA SATIVA L. Sp. Pl. 333. 1753.

Annual; culms erect, up to 1 m. high or more; sheaths all longer than the internodes, soft, glabrous, auriculate, the auricles sometimes hispid-ciliate; ligule acuminate, mostly 1–2 cm. long; blades 20–40 cm. long, 1–1.5 cm. wide, acuminate, scabrous; panicles 10–30 cm. long, narrow, dense, becoming top-heavy; spikelets oblong, 7–10 mm. long; glumes narrow, 2–3 mm. long; lemmas hard, ridged by the lateral nerves, more or less hispid, especially on the keel, awnless or awned, the awn variable.

Cultivated throughout tropical and warm temperate regions at low altitudes.

COCLÉ: Penonomé, *Williams 71*. CANAL ZONE: Río Paraíso, *Standley 29904*. PANAMÁ: Pacora, *Killip 4198*; Taboga, *Killip 4150*; Juan Díaz, *Standley 30620*. SAN BLAS: Puerto Obaldía, *Pittier 4367*.

2. ORYZA PERENNIS Moench, Meth. Pl. 197. 1797.

Erect slender to coarse perennial; culms 0.5–2 m. high, soft, succulent, glabrous; ligule 5–40 mm. long, acuminate, the short ligules on small plants; blades elongate, 7–14 mm. wide (short and narrower in small plants), scabrous on the margins; panicles 7–20 cm. long, narrow, the branches ascending or appressed; spikelets 8–9 mm. long, oblong; glumes 2–4 mm. long, narrow, acuminate, sometimes erose-dentate, glabrous; lemma sparsely appressed-hispid, hispid-ciliate on the keel, the tip pale or usually purple; palea sparsely hispid-ciliate on the keels with a tuft of short hairs on the tip; awn 5–10 cm. long, slender, very scabrous.

Swamps and wet savannas, often standing in water, Cuba and Hispaniola; Panama to Brazil.

COCLÉ: Aguadulce, *Pittier 4892*.

3. ORYZA LATIFOLIA Desv. Jour. de Bot. (Desv.) 1:77. 1813.

Oryza sativa var. *β. latifolia* Doell in Mart. Fl. Bras. 2^3:7. 1871.

Coarse erect perennial; culms 1–2 m. high, succulent, scaberulous; sheaths elongate, longer than the internodes, keeled toward the summit, glabrous, pubescent on the collar, auriculate, the auricles sometimes hispid-ciliate; ligule 3–5 mm. long, hispid; blades mostly 30–50 cm. long, 1–3.5 cm. wide, scabrous and sparsely pubescent on both surfaces, the margins prominently hispid-scabrous; panicles 30–40 cm. long, the branches verticillate, ascending, scabrous, as much as 25 cm. long, naked toward the base; spikelets 5 mm. long, short-pedicellate, oblong, sparsely hispid, the awns 1–2 cm. long or sometimes wanting; glumes narrow, acuminate, 1 mm. long.

Marshes and along rivers and ditches, British Honduras and the West Indies to Brazil.

CANAL ZONE: Fort Randolph, *Standley 28726*; between Mindi and Colón, *Hitchcock 7945*; between France Field, Canal Zone, and Catival, Colón, *Standley 30447*; Gatún,

Hitchcock 9176, 9176½; Culebra, *Hitchcock 7905.* PANAMÁ: Matías Hernández, *Pittier 6791.*

38. LEERSIA Swartz

LEERSIA Swartz, Prodr. Veg. Ind. Occ. 21. 1788. (Conserved).
Homalocenchrus Mieg, Act. Helv. Phys. Math. 4:307. 1760.
Asprella Swartz, Prodr. Veg. Ind. Occ. 21. 1788.
Endodia Raf. Neogenyt. 4. 1825.
Aplexia Raf. Bull. Bot. Seringe 1:220. 1830.

Spikelets 1-flowered, disarticulating below the glumes, laterally compressed; glumes wanting; lemma awnless, chartaceous, oblong, usually 5-nerved, the lateral nerves close to the margins, these and the keel often hispid-ciliate; palea as long as the lemma, 3-nerved, the lateral nerves near the margins, usually hispid-ciliate, the margins firmly held by the margins of the lemma; stamens 1–6.

a. Panicles 15–40 cm. long, the slender branches spreading, as much as 15 cm. long, spikelet bearing only toward the ends; spikelets 2–2.5 mm. long ..... 1. L. GRANDIFLORA
aa. Panicles 4–15 cm. long, the branches narrowly ascending, 1–4 cm. long, spikelet bearing nearly to the base; spikelets 3 mm. long ..... 2. L. HEXANDRA

1. LEERSIA GRANDIFLORA (Doell) Prodoehl, Bot. Archiv (Mez) 1:219. 1922.
Oryza monandra var. *β. grandiflora* Doell in Mart. Fl. Bras. 2^2:9. 1871.
Homalocenchrus grandiflorus Hitchc. Contr. U. S. Nat. Herb. 17:273. 1913.

Perennial; culms relatively slender, erect, 1–2 m. high, glabrous or sparsely hispid below the nodes, the nodes densely retrorsely bearded; sheaths usually longer than the internodes, keeled toward the summit, auriculate, retrorsely papillose-hispid, sometimes sparsely so; ligule 1-2 mm. long, truncate-erose, fused with the auricles of the sheath; blades flat, 15–30 cm. long, 1–1.5 cm., rarely as much as 2 cm., wide, scabrous, sometimes sparsely appressed-hispid; panicles 15–40 cm. long, open, the relatively few distant widely ascending slender branches as much as 15 cm. long, spikelet bearing only toward the ends; spikelets 2–2.5 mm. long, sparsely hispid-scabrous on the nerves, otherwise nearly glabrous; stamens 2.

Shady banks and borders of streams, Mexico to Brazil.
CHIRIQUÍ: El Boquete, *Hitchcock 8300.*

2. LEERSIA HEXANDRA Swartz, Prodr. Veg. Ind. Occ. 21. 1788.
Asprella hexandra Beauv. Ess. Agrost. 2, 153. 1812.
Leersia mexicana H.B.K. Nov. Gen. & Sp. 1:195. 1816.
Asprella mexicana Roem. & Schult. Syst. Veg. 2:267. 1817.
Leersia contracta Nees, Agrost. Bras. 516. 1829.
Oryza hexandra Doell in Mart. Fl. Bras. 2^2:10. 1871.
Oryza mexicana Doell in Mart. Fl. Bras. 2^2:10. 1871.
Leersia gouinii Fourn. Mex. Pl. 2:2. 1886.
Homalocenchrus gouinii Kuntze, Rev. Gen. Pl. 2:777. 1891.
Homalocenchrus hexandrus Kuntze, Rev. Gen. Pl. 2:777. 1891.
Leersia dubia Areschoug, Svensk Freg. Eugenies Resa, 115. 1910; Repert. Sp. Nov. (Fedde) 10:299. 1912.

Aquatic perennial; culms slender, erect from a decumbent or creeping base,

rooting at the lower nodes, 0.5 to more than 1 m. long, the nodes retrorsely hirsute; sheaths shorter than the internodes, keeled, glabrous, auriculate, the auricles acuminate; ligule 1–3 mm. long, truncate, fused with the auricles; blades 4–20 cm. long, 4–12 mm. wide, scabrous; panicles 4–15 cm. long, narrow, the short branches 1–4 cm. long, narrowly ascending, floriferous nearly to base; spikelets 3 mm. long, hispid, strongly hispid-ciliate on the keels of the lemma and palea; stamens 2.

Swamps, wet ditches, and margins of rivers and lakes, southern United States, and the West Indies to Argentina.

COCLÉ: Aguadulce, *Pittier 4909*. CANAL ZONE: Río Chagres, *Fairchild 2049*; Gatún, *Hitchcock 7967*; Barro Colorado Island, *Kenoyer 127*; Balboa, *Hitchcock 8007*. PANAMÁ: Matías Hernández, *Standley 28985*; Panamá, *Piper 5247*; Chepo, *Pittier 4552*.

39. PHARUS L.

PHARUS L. Syst. Nat. ed. 10. 2:1269. 1759.

Spikelets unisexual, 1-flowered, in pairs, one pistillate, sessile, the other staminate, long-pedicellate, appressed along the panicle branches; staminate spikelets small; glumes unequal, the first shorter, 1-nerved, the second about as long as the floret, 3-nerved; lemma acute or subacute; stamens 6; pistillate spikelet large, terete; glumes short and acuminate to nearly as long as the floret, 3- to several-nerved; lemma becoming indurate with a minute beak, straight or curved, partly to almost completely covered on the back with uncinate hairs, the margins involute, tightly enclosing the palea; stigmas 3.

Erect or decumbent perennials with broad, thin, petiolate, obliquely nerved, transversely veined blades, and open panicles, the pairs of spikelets appressed along the branches; main axis short or elongate, terminating in a long slender bristle, the branch from the base of this bristle continuing the panicle making it appear unsymmetrical, this branch articulate at the base and readily deciduous.

a. Fruit 2.2–2.7 cm. long, slender and slightly hooked at the tip, 4–5 times as long as the short acuminate glumes ..... 1. P. CORNUTUS
aa. Fruit not more than 15 mm. long, not more than twice as long as the glumes.
  b. Fruit S-shaped ..... 2. P. LONGIFOLIUS
  bb. Fruit straight or only slightly curved near the summit.
    c. Fruit pubescent only near the tip, slender, 15 mm. long, curved near the summit ..... 3. P. LATIFOLIUS
    cc. Fruit pubescent nearly to the base, plump, straight or slightly curved.
      d. Glumes of pistillate spikelet green, more than half as long as the fruit ..... 4. P. VIRESCENS
      dd. Glumes of pistillate spikelet reddish-brown, not more than half as long as the fruit.
        e. Culms erect; blades 3.5–4 cm. wide; staminate spikelets 3–4 mm. long ..... 5. P. GLABER
        ee. Culms decumbent, rooting at the lower nodes; blades 1.5–3 cm. wide; staminate spikelets 2 mm. long ..... 6. P. PARVIFOLIUS

1. PHARUS CORNUTUS Hack. Oesterr. Bot. Zeitschr. 52:9. 1902.

Perennial; culms erect, 30–65 cm. high; sheaths scaberulous, longer than the

internodes or the lower ones sometimes shorter than the internodes; ligule 1–2 mm. long, brown, erose-ciliate; blades mostly 8–15 cm. long, 3.5–7 cm. wide, or the lower ones and those on small shoots smaller, obovate, rather abruptly narrowed to an acute or acuminate tip, narrowed to a petiole-like base about 1 cm. long, glabrous or scaberulous, sometimes pubescent near the base; panicle 12–20 cm. long, the branches ascending with usually spreading branchlets, the main axis terminating in a staminate spikelet; staminate spikelets 4 mm. long, pubescent; first glume 1–2 mm. long, 1-nerved, narrow, acuminate; second glume 2–3 mm. long, 5-nerved, much broader than the first, obtuse, apiculate; lemma acute, 5- to 7-nerved, the nerves rather prominent; pistillate spikelet 2.2–2.7 cm. long, short-pedicellate, spreading; glumes narrow, acuminate, pubescent, the first 3.5–4 mm. long, 3-nerved, the second about 5 mm. long, 5-nerved; fruit straight, hooked at the tip, sparsely covered with fine uncinate hairs toward the base, the hairs becoming dense toward the summit.

Wet forests, Costa Rica and Panama.

BOCAS DEL TORO: Chiriquí Lagoon, *von Wedel 2189, 2287.*

2. PHARUS **longifolius** Swallen, sp. nov.

Perennis; culmi erecti, 120 cm. alti, minute pubescentes; vaginae elongatae, scaberulae; laminae 25–35 cm. longae, 5–6.5 cm. latae, oblanceolatae, abrupte acutae vel acuminatae, supra glabrae, infra scabrae; paniculae 40 cm. longae, ramis adscendentibus, remotis, ramulis divaricatis, implicatis; spiculae masculae 3.8–4 mm. longae, pubescentes; spiculae femineae 12–14 mm. longae; glumae angustae, acuminatae, pubescentes, fructu dimidio breviores; fructus curvatus in dimidio superiore dense pubescens, apice glaber.

Perennial; culms erect, 120 cm. high, minutely crisp-pubescent; sheaths mostly of nearly equal length, elongate, scaberulous; body of blade 25–35 cm. long, 5–6.5 cm. wide, oblanceolate, gradually narrowed to a rather long petiole-like base, rather abruptly narrowed near the tip to an acute or acuminate apex, glabrous above, scabrous beneath; panicle long-exserted, the main axis 40 cm. long, the stiffly ascending branches solitary, distant, the branchlets divaricate, implicate; staminate spikelet 3.8–4 mm. long, pubescent, the glumes acute, the first about half, the second two-thirds as long as the lemma; lemma acuminate; pistillate spikelet 12–14 mm. long; glumes about half as long as the fruit, narrow, acuminate, pubescent; fruit slender S-shaped, densely pubescent from below the middle, the pointed tip glabrous.

Wet or moist forests, Panama and Colombia.

PANAMÁ: PANAMÁ: Río Tecúmen, *Standley 26694;* Alhajuela, *Dodge, Steyermark & Allen 16508;* Matías Hernández, in shady woods, Jan. 1-15, 1915, *Pittier 6941* (U. S. Nat. Herb., TYPE). COLOMBIA: Cartagena, *Bro. Heriberto 261.*

Related to *P. mezii* Prodoehl and resembling it in the S-shaped fruits. In that species, however, the culms are only about 40 cm. high with panicles scarcely 15 cm. long, the branchlets not implicate; the staminate spikelets are glabrous, only 2 mm. long, and the glumes of the pistillate spikelet are glabrous or nearly so.

3. Pharus latifolius L. Syst. Nat. ed. 10. 2:1269. 1759.

Erect perennial; culms 40-80 cm. high, glabrous; sheaths glabrous, keeled, all longer than the internodes, the lower ones elongate; blades oblanceolate, 10-30 cm. long, mostly 3.5–8.5 cm. wide, narrowed to a petiolate base, the petiole sometimes as much as 10 cm. long, the tip abruptly acuminate; panicles 10–30 cm. long, the branches stiffly ascending or spreading, rarely reflexed, sometimes reduced to a single branch; staminate spikelet 4 mm. long, glabrous or minutely scabrous; glumes obtuse, the first about 1 mm. long, the second 2.5–3.5 mm. long; pistillate spikelets 15 mm. long, subsessile or short-pedicellate, appressed; glumes 8–12 mm. long, acute or subobtuse, the second a little longer than the first; fruit slender, slightly curved at the tip, densely pubescent near the summit for a short distance, otherwise glabrous.

Moist forests, British Honduras and the West Indies to Peru and Brazil.

Bocas del Toro: Laguna de Chiriquí, *Hart 77; Carleton 196; von Wedel 1416, 1552, 1736;* Changuinola Valley, *Stork 100.* Chiriquí: San Felix, *Pittier 5744.* Colón: Loma de la Gloria, *Pittier 4088.* Canal Zone: Frijoles, *Standley 27430;* Barro Colorado Island, *Standley 31259, 40920; Kenoyer 104; D. H. Popenoe 39;* Juan Mina, *Bartlett & Lasser 16788;* Ancón Hill, *Standley 25176.* Panamá: Juan Díaz, *Standley 30617;* Río Tapia, *Standley 28092.*

4. Pharus virescens Doell in Mart. Fl. Bras. 2^2:1, 21. 1871.

Perennial; culms erect from a usually decumbent base, often rooting at the lower nodes, 50 cm. to more than 1 m. long; sheaths all overlapping, flattened but scarcely keeled, glabrous; blades oblanceolate, gradually narrowed to the base, somewhat abruptly narrowed toward the end to an acuminate apex, scaberulous, 12–35 cm. long, 3–6.5 cm. wide at the widest place; panicles 15–30 cm. long, the branches as much as 23 cm. long, relatively few-flowered; staminate spikelets 3–4 mm. long, the first glume subobtuse, one-third to half, the second acuminate, as long as the spikelet; fertile spikelet 12-15 mm. long, the glumes equal, 8–11 mm. long, lanceolate, 3- to 5-nerved, acute or subacute, green; fruit straight or slightly curved, pubescent across the back at the summit, the pubescence extending down the sides nearly to the base, the lower part of the back and narrow margins glabrous.

Wet forests and scrub, Dominican Republic; Guatemala to Brazil and Peru.

Panamá: Río Tecúmen, *Hunter & Allen 248.*

5. Pharus glaber H.B.K. Nov. Gen. & Sp. 1:196. 1816.

Perennial; culms erect, 50–75 cm. high, glabrous; sheaths glabrous, smooth and shining; blades broadly lanceolate, mostly 15–18 cm. long, 3.5–4 cm. wide, gradually tapering toward both ends, acute, glabrous, shining; panicles 15–30 cm. long, the branches distant, stiffly ascending; staminate spikelets 3–4 mm. long, glabrous; glumes obtuse, the first one-third, the second about two-thirds as long as the floret; pistillate spikelets 9–12 mm. long; glumes equal, about half as long as the fruit, brown, glabrous; fruit plump, straight, densely pubescent to the base, the pointed glabrous tip about 1 mm. long.

Forests, Mexico and the West Indies to Colombia and Brazil.

CHIRIQUÍ: El Boquete, *Hitchcock 8308*.

6. PHARUS PARVIFOLIUS Nash, Bull. Torrey Club 35:301. 1908.

Perennial; culms decumbent at the base, rooting at the lower nodes, mostly 60–100 cm. long; sheaths much overlapping, keeled, glabrous; blades lanceolate, acuminate, glabrous, mostly 15–20 cm. long, 15–30 mm. wide; panicles mostly 15–20 cm. long, the pubescent branches and branchlets stiffly and abruptly ascending to spreading; staminate spikelets 2 mm. long; pistillate spikelets 11–14 mm. long; glumes subequal, acute, about half as long as the fruit; fruit plump, densely pubescent all over except near the base and on the short, pointed tip.

Moist forests, Mexico and the West Indies to Brazil.

CANAL ZONE: Barro Colorado Island, *Bailey & Bailey 546*.

40. LUZIOLA Juss.

LUZIOLA Juss. ex Gmel. Syst. Nat. ed. 13. 2:637. 1791.

Monoecious, the staminate and pistillate spikelets in separate inflorescences, the staminate usually terminal, the pistillate from the middle and upper nodes; glumes wanting; lemma and palea nearly equal, thin, several- to many-nerved, the nerves more prominent in the pistillate spikelets; stamens several; stigmas long, plumose; caryopsis free, subspherical, smooth or minutely striate.

1. LUZIOLA **subintegra** Swallen, sp. nov.

Perennis natans; vaginae inflatae internodiis longiores, transverse nervosae, glabrae, auriculatae, auriculae 1–8 cm. longae; laminae elongatae, acuminatae, 1–2.5 cm. latae, scabrae et sparse pilosae, marginibus serratis; paniculae masculae 12–15 cm. longae, ramis gracilibus, inferioribus subverticillatis adscendentibus vel patentibus; spiculae 6 mm. longae, glabrae; paniculae femineae 5–6 cm. longae, dense multiramosae, ramis subglabris implicatis apice spiculo; spiculae 4–5 mm. longae, acuminatae, pallidae, forte nervosae; caryopsis subglobosa, minute striata, 2 mm. longa.

Aquatic perennial; culms rather thick, succulent, rooting at the nodes, frequently floating, glabrous; sheaths loose, inflated, transversely veined, usually longer than the internodes, glabrous, auriculate, the auricles 1–8 cm. long, fused with the ligule, attenuate to a fine point; blades elongate, acuminate, 1–2.5 cm. wide, gradually narrowed to the thickened base, scabrous and sparsely pilose on both surfaces, the margins hispid-scabrous, almost serrate; staminate panicles 12–15 cm. long, the slender branches ascending to spreading, sparsely pilose, rather densely villous in the axils, the lowest ones subverticillate; spikelets 6 mm. long, the lemma and palea thin, glabrous; pistillate inflorescences partly enclosed, protruding sidewise from the inflated sheaths, 5–6 cm. long, about as broad; branches numerous, at first stiffly ascending, finally spreading or reflexed, implicate, glabrous, terminating in a spikelet, the peduncle flat, weak, easily drooping, the panicle

turned downward in the water; spikelets at time of flowering 4–5 mm. long, narrow, acuminate, pale, the lemma and palea thin, but not readily disintegrating, prominently nerved, bulged out at maturity exposing the fruit; caryopsis 2 mm. long, subspherical, minutely striate.

CANAL ZONE: floating in Chagres River at Juan Mina, June 25–Aug. 29, 1940, *Bartlett & Lasser 16816* (TYPE).

Similar in habit to *L. spruceana* Benth. but differing in the characters of the pistillate inflorescences. In *L. spruceana* the branches of the pistillate panicles are very scabrous, not terminating in a spikelet, and the lemma and palea are fragile, readily disintegrating between the nerves leaving the caryopsis subtended by bristles. The nerves of the lemma and palea are also more scabrous than in *L. subintegra*.

41. ARUNDINELLA Raddi

ARUNDINELLA Raddi, Agrost. Bras. 36. *pl. 1. f. 3.* 1823.

Spikelets short-pedicelled in rather dense contracted panicles; glumes acuminate, the first 3- to 5-nerved, the second 5-nerved, much longer than the first; sterile lemma acute, 3- to 5-nerved, a little shorter to a little longer than the first glume, containing a well-developed palea; fertile floret much shorter than the sterile lemma, with a short bearded callus and a terminal geniculate awn.

Slender to coarse perennials with narrow blades and small to large contracted panicles.

a. Awns 2–5 mm. long, tightly twisted below the bend.
  b. Spikelets 3 mm. long; awns 2 mm. long, the twisted segment about as long as the sterile lemma ..... 1. A. HISPIDA
  bb. Spikelets 4.5–5 mm. long; awns about 5 mm. long, the twisted segment about 2 mm. long, distinctly longer than the sterile lemma ..... 2. A. CONFINIS
aa. Awns 8–12 mm. long, not twisted, or only slightly so toward maturity.
  b. Culms coarse, 1–2.5 m. high; sheaths densely papillose-hispid ..... 3. A. DEPPEANA
  bb. Culms slender, 30–60 cm. high; sheaths glabrous ..... 4. A. BERTERONIANA

1. ARUNDINELLA HISPIDA (Humb. & Bonpl.) Kuntze, Rev. Gen. Pl. 2:761. 1891.

Andropogon hispidus Humb. & Bonpl. ex Willd. Sp. Pl. 4:908. 1806.
Ischaemum hispidum H.B.K. Nov. Gen. & Sp. 194. 1816.
Arundinella brasiliensis Raddi, Agrost. Bras. 37. 1823.

Erect perennial; culms 1–1.7 m. high, more slender than *A. deppeana*, glabrous, the nodes densely appressed-pubescent; sheaths mostly shorter than the internodes, papillose-hispid toward the summit or sometimes only papillose; ligule about 0.5 mm. long; blades firm, usually elongate, 5–12 mm. wide, densely hispid, or papillose only; panicles 10–30 cm. long, erect, dense, greenish-purple, the branches narrowly ascending; spikelets 3 mm. long; first glume shorter than or about as long as the sterile floret, the second a little longer, bluntly acuminate; awn of fertile floret about 2 mm. long, tightly twisted below, the twisted part about equaling the sterile floret, the terminal part stiffly spreading.

Wet meadows and grassy hillsides, Panama to Argentina.

CHIRIQUÍ: El Boquete, *Hitchcock 8183, 8320, 8321;* Bajo Boquete, *Killip 8183.*

2. ARUNDINELLA CONFINIS (Schult.) Hitchc. & Chase, Contr. U. S. Nat. Herb., 18:290. 1917.

Piptatherum confine Schult. Mant. 2:184. 1824.
Arundinella martinicensis Trin. Gram. Pan. 62. 1826.
Arundinella pallida Nees, Agrost. Bras. 465. 1829.

Similar in size and habit to *A. hispida;* sheaths papillose only, or glabrate; spikelets 4.5–5 mm. long, the awn of the fertile floret commonly 5 mm. long, the lower twisted portion about 2 mm. long, distinctly longer than the sterile lemma.

Grassy slopes, southern Mexico and the West Indies to Paraguay.

CHIRIQUÍ: El Boquete, *Killip 4521.* CANAL ZONE: Red Tank to Pueblo Nuevo, *Piper 5220.*

3. ARUNDINELLA DEPPEANA Nees in Steud. Syn. Pl. Glum. 1:115. 1854.
Arundinella phragmitoides Griseb. Cat. Pl. Cuba, 234. 1866.

Coarse perennial; culms erect, 1–2.5 m. high, glabrous; sheaths all much longer than the internodes, rather firm but loose, densely papillose-hispid with appressed hairs, especially toward the summit; ligule membranaceous, about 0.5 mm. long, blades elongate, attenuate, flat, scabrous and sparsely to densely papillose-hispid; panicles 25–70 cm. long, dense, somewhat interrupted below, the slender straight or commonly flexuous branches in dense closely overlapping fascicles, some naked at the base, the lower ones 10–15 cm., or rarely as much as 25 cm. long; spikelets 4–5 mm. long, appressed; glumes acuminate, the first 3-nerved, the second much longer than the first, 5-nerved; sterile lemma acute; awn of fertile floret about 1 cm. long, geniculate, not twisted, slender and flexuous above the bend.

Dry savannas, thickets and hillsides, Mexico and the West Indies to Brazil.

CHIRIQUÍ: El Boquete, *Hitchcock 8307; Killip 4508; Davidson 802.* COCLÉ: La Venta Beach, *Muenscher 12210.* CANAL ZONE: Empire to Mandinga, *Piper 5254;* East Paraíso, *Standley 30038;* Pedro Miguel, *Killip 4310;* Victoria Fill, *Allen 1714;* between Panamá and Corozal, *Hitchcock 9199;* between Fort Clayton and Corozal, *Standley 29024;* Balboa Heights, *Greenman & Greenman 5051.* PANAMÁ: Pacora, *Killip 4242;* Río Tecúmen, north of Chepo road, *Hunter & Allen 241.*

4. ARUNDINELLA BERTERONIANA (Schult.) Hitchc. & Chase, Contr. U. S. Nat. Herb. 18:290. 1917.

Trichochloa berteroniana Schult. Mant. 2:209. 1824.
Muhlenbergia berteroniana Kunth, Rév. Gram. 1:64. 1829.
Arundinella peruviana Steud. Syn. Pl. Glum. 1:115. 1854.
Arundinella cubensis Griseb. Mem. Amer. Acad. (n. s.) 8:533. 1862.

Slender perennial; culms densely tufted, erect, 30–60 cm., or sometimes as much as 1 m. high, glabrous, the nodes appressed-pubescent; sheaths glabrous, sparsely hispid in the throat and on the collar, the margins glabrous or ciliate; ligule ciliate, very short; blades commonly 10–20 cm. long, 2–5 mm. wide, flat or sometimes involute, papillose or papillose-hispid; panicles 10–30 cm. long, rather lax, the ascending branches not densely-flowered, floriferous to the base; spikelets 4–5 mm. long, the slender awn of the fertile floret 8–12 mm. long, not twisted below, geniculate, the terminal portion spreading or reflexed.

Rocky river banks, Mexico and the West Indies to Brazil.

BOCAS DEL TORO: *Carleton 216.* COCLÉ: Río Mata Ahogado, *Allen 128, 140.* PANAMÁ: Juan Díaz River, *Killip 4261;* Quebrada La Palma, *Dodge & Allen 17361;* Quebrada Peluca, *Steyermark & Allen 17251;* Río Chilibre, *Piper 5272.*

42. LEPTOCORYPHIUM Nees

LEPTOCORYPHIUM Nees, Agrost. Bras. 83. 1829.

Spikelets lanceolate, paniculate; first glume wanting, second glume and sterile lemma subequal, longer than the fruit, the glume 3-nerved, the lemma 5-nerved, both covered with white silky hairs; fruit reddish-brown with a thin hyaline tip, scarcely indurate, the margins of the lemma not inrolled, the palea free at the summit.

Densely tufted perennials with long narrow blades and small, narrow, somewhat silky panicles.

1. LEPTOCORYPHIUM LANATUM (H.B.K.) Nees, Agrost. Bras. 84. 1829.

Paspalum lanatum H.B.K. Nov. Gen. & Sp. 1:94. *pl. 29.* 1815.
Milium lanatum Roem. & Schult. Syst. Veg. 2:322. 1817.
Anthaenantia lanata Benth. Jour. Linn. Soc. Bot. 19:39. 1881.

Perennial; culms 50–100 cm. high in small dense tufts; leaves somewhat crowded toward the base, the blades elongate, flat or folded, sometimes involute, 2–4 mm. wide, scabrous; panicles 6–17 cm. long, narrow but loose, the branches narrowly ascending or rarely spreading; spikelets 4 mm. long, densely pilose with pale, silky, appressed or spreading hairs.

Open grassy savannas and hillsides, Mexico and the West Indies to Argentina.

CANAL ZONE: Ancón Hill, *Killip 4343.*

43. TRICHACHNE Nees

TRICHACHNE Nees, Agrost. Bras. 85. 1829.

Valota Adans. Fam. Pl. 2:495. 1763.

Spikelets lanceolate, rather distant, in pairs in two rows on one side of a narrow rachis; first glume small, hyaline, nerveless, glabrous; second glume and sterile lemma nearly equal, longer than the fruit, 3- to 5-nerved, densely covered with usually long silky, pale or tawny hairs; fruit cartilaginous, acuminate, dark brown at maturity, the tip pale, the margins of the lemma broad, thin, hyaline, nearly covering the palea, not inrolled.

Slender to rather coarse perennials with flat narrow blades and plume-like (in our species) contracted inflorescences of numerous slender racemes scattered on an elongate common axis.

1. TRICHACHNE INSULARIS (L.) Nees, Agrost. Bras. 86. 1829.

Andropogon insularis L. Syst. Nat. ed. 10. 2:1304. 1759.
Panicum lanatum Rottb. Act. Lit. Univ. Hafn. 1:269. 1778.

Milium villosum Swartz, Prodr. Veg. Ind. Occ. 24. 1788.
Milium hirsutum Beauv. Ess. Agrost. 13. *pl. 5. f. 5.* 1812.
Panicum leucophaeum H.B.K. Nov. Gen. & Sp. 1:97. 1815.
Panicum insulare G. Meyer, Prim. Fl. Esseq. 60. 1818.
Saccharum polystachyum Sieb. ex Kunth, Enum. Pl. 1:124. 1833.
Panicum saccharoides A. Rich. in Sagra, Hist. Cuba 11:306. 1850. Not *P. saccharoides* Trin., 1826.
Panicum falsum Steud. Syn. Pl. Glum. 1:67. 1854.
Panicum duchaissingii Steud. Syn. Pl. Glum. 1:93. 1854.
Tricholaena saccharoides Griseb. Abhandl. Gesell. Wiss. Göttingen 7:265. 1857.
Tricholaena insularis Griseb. Abhandl. Gesell. Wiss. Göttingen 7:265. 1857.
Digitaria leucophaea Stapf in Thiselt.-Dyer, Fl. Cap. 7:382. 1898.
Panicum insulare var. *leucophaeum* Kuntze, Rev. Gen. Pl. 3^3:361, 362. 1898.
Syntherisma insularis Millsp. & Chase, Field Mus. Bot. 1:473. 1902.
Valota insularis Chase, Proc. Biol. Soc. Washington 19:188. 1906.
Digitaria insularis Mez ex Ekman, Arkiv Bot. 13^{10}:22. 1913.
Andropogon fabricii Herzog ex Henr. Med. Rijks Herb. Leiden 40:44. 1921.

Perennial; culms erect or decumbent-spreading at the base, from a knotty rhizomatous base, branching, mostly 1–1.5 m. high, usually many-noded, the internodes relatively short; cataphylls densely and softly hairy; sheaths keeled toward the summit, longer than the internodes, sparsely papillose-pilose or papillose-hirsute, the lower ones often densely so, with a tuft of hairs in the throat; ligule thin, 3–4 mm. long; blades 10–30 cm. long, 2–12 mm. wide, flat, acuminate to attenuate-pointed, finely scabrous on the margins; panicles 15–30 cm. long, narrow, dense, tawny, silky, the branches narrowly ascending, spikelet-bearing from the base; spikelets 3.5–4 mm. long, obscured by the long silky hairs, the first glume about 0.5 mm. long, glabrous.

Open ground and waste places, Texas to Florida, Mexico and the West Indies to Argentina. Common in Panama.

CANAL ZONE: Fort Sherman, *Maxon & Valentine 7021;* Frijoles, *Piper 5243;* Culebra, *Hitchcock 7896; Pittier 2087;* Summit, *Standley 30125;* Ancón, *Bro. Celestine 24;* Balboa, *Standley 26106.* PANAMÁ: Point Chamé, *Hitchcock 8156, 8158;* Taboga Island, *Hitchcock 8097.*

44. DIGITARIA Heist.

DIGITARIA Heist. ex Scop. Fl. Carn. ed. 2. 1:52. 1772.
Syntherisma Walt. Fl. Carol. 76. 1788.

Spikelets solitary, in pairs, or in groups of 3–5, alternate in two rows on one side of a 3-angled, winged or wingless rachis, the first glume turned away from the rachis; first glume wanting, or present as a smaller or minute nerveless scale; second glume from much shorter to as long as the spikelet; sterile lemma as long as or slightly longer than the fruit, 5-nerved, the lateral nerves sometimes approximate near the margin; fruit cartilaginous, pale or dark brown, the hyaline margins of the lemma not inrolled.

Annuals or perennials with usually flat blades and slender racemes, digitate or approximate on the common axis.

a. Plants annual; culms decumbent-spreading, or if erect, freely branching at the base.
  b. Culms widely spreading, usually rooting at the lower nodes.
    c. First glume present, small, nerveless; rachis narrowly winged; second glume distinctly shorter than the fruit.
      d. Spikelets 3 mm. long, the sterile lemma usually conspicuously villous on the margins; rachis 1 mm. wide, without scattered long white hairs ..... 1. D. SANGUINALIS
      dd. Spikelets 2 mm. long, the sterile lemma subglabrous or inconspicuously pilose; rachis about 0.4 mm. wide with a few scattered long white hairs ..... 2. D. HORIZONTALIS
    cc. First glume wanting; rachis wingless; second glume and sterile lemma equal, longer than the fruit ..... 3. D. LANUGINOSA
  bb. Culms erect in small tufts.
    c. Racemes 10.5–13 cm. long, curved; sheaths papillose or papillose-hirsute; spikelets with no tufts of hairs at the tip ..... 4. D. HIRSUTA
    cc. Racemes 1–5 cm. long, stiffly ascending; sheaths pubescent or villous; spikelets with a dense tuft of yellowish hairs at the tip ..... 5. D. ARGILLACEA
aa. Plants perennial; culms erect, simple; racemes appressed or narrowly ascending.
  b. Second glume nearly as long as the fruit; racemes 1–3, 2.5–7 cm. long; sheaths pilose or hirsute ..... 6. D. SINGULARIS
  bb. Second glume about one-fourth as long as the fruit, obtuse, sometimes shallowly lobed, glabrous; racemes 4–5, about 15 cm. long, brownish from the exposed fruits; sheaths glabrous ..... 7. D. CURTIGLUMA

1. DIGITARIA SANGUINALIS (L.) Scop. Fl. Carn. ed. 2. 1:52. 1772.

Panicum sanguinale L. Sp. Pl. 57. 1753.
Dactylon sanguinalis L. ex Vill. Hist. Pl. Dauph. 2:69. 1787.
Syntherisma praecox Walt. Fl. Carol. 76. 1788.
Paspalum sanguinale Lam. Tabl. Encycl. 1:176. 1791.
Digitaria praecox Willd. Enum. Pl. 91. 1809.
Panicum adscendens H.B.K. Nov. Gen. & Sp. 1:97. 1815.
Cynodon praecox Roem. & Schult. Syst. Veg. 2:412. 1817.
Digitaria marginata Link, Enum. Pl. 1:102. 1821.
Digitaria fimbriata Link, Hort. Berol. 1:226. 1827.
Panicum fimbriatum Kunth, Rév. Gram. 1:33. 1829.
Panicum linkianum Kunth, Rév. Gram. 1:33. 1829.
Syntherisma sanguinalis Dulac, Fl. Haut. Pyr. 77. 1867.
Syntherisma fimbriatum Nash, Bull. Torrey Club 25:302. 1898.
Syntherisma marginatum Nash, N. Amer. Fl. 17:154. 1912.
Digitaria marginata var. *fimbriata* Stapf in Prain, Fl. Trop. Afr. 9:440. 1919.
Panicum sanguinale subsp. *marginatum* Thell. Vierteljahrs. Nat. Ges. Zürich 64:699. 1919.
Digitaria sanguinalis var. *marginata* Fernald, Rhodora 22:103. 1920.
Digitaria adscendens Henr. Blumea 1:92. 1934.
Digitaria nealleyi Henr. Blumea 1:94. 1934.

Decumbent or geniculate-spreading annual; culms geniculate and commonly rooting at the lower nodes, ascending, 15 cm. to more than 1 m. long; sheaths shorter than the internodes, sparsely to rather densely papillose-hirsute; ligule membranaceous, truncate, 1–2 mm. long; blades 2–10 cm. long, or sometimes longer in robust specimens, 2–9 mm. wide, scabrous, sparsely to rather densely pilose or papillose-pilose with prominent white midnerve and margins; racemes 2–several, digitate or with a second whorl a short distance below, the rachis about 1 mm. wide, narrowly winged; spikelets 3 mm. long, the first glume small but plainly evident; second glume acuminate, about three-fourths as long as the fruit;

sterile lemma slightly longer than the fruit, from nearly glabrous to prominently villous on the margins.

A common weed in cultivated ground and waste places, in warm temperate and tropical regions around the world.

CHIRIQUÍ: El Boquete, *Hitchcock 8233, 8314.* CANAL ZONE: between Mindi and Colón, *Hitchcock 7941;* Frijoles, *Pittier 3761;* Gamboa, *Pittier 4440; Standley 28504;* Culebra, *Hitchcock 7915; Pittier 2650;* Summit, *Standley 30092;* Corozal, *Piper 5262;* between Corozal and Ancón, *Pittier 2185;* Ancón, *Piper 5235; Bro. Celestine 23;* Balboa, *Standley 25493; McBride & Featherstone 42;* Balboa Heights, *Killip 4255.* PANAMÁ: Matías Hernández, *Pittier 6853;* Panamá, *Hitchcock 22948;* Chepo, *Pittier 4464.*

2. DIGITARIA HORIZONTALIS Willd. Enum. Pl. 92. 1809.

Phalaris velutinus Forsk. Fl. Aegypt. Arab. 17. 1775. Not *Digitaria velutina* Hitchc. 1927.
Milium digitatum Swartz, Prodr. Veg. Ind. Occ. 24. 1788. Not *Digitaria digitata* Buse, 1854.
Axonopus digitatus Beauv. Ess. Agrost. 12, 154. 1812.
Panicum horizontale G. Meyer, Prim. Fl. Esseq. 54. 1818.
Digitaria setosa Desv. ex Hamilt. Prodr. Pl. Ind. Occ. 6. 1825.
Digitaria jamaicensis Spreng. Syst. Veg. 1:272. 1825.
Paspalum digitatum Kunth, Rév. Gram. 1:24. 1829.
Panicum hamiltonii Kunth, Rév. Gram. 1: Suppl. IX. 1830.
Syntherisma setosa Nash, Bull. Torrey Club 25:300. 1898.
Panicum sanguinale var. *digitatum* Hack. ex Urban, Symb. Antill. 4:86. 1903.
Panicum sanguinale subsp. *horizontale* Hack. Ergeb. Bot. Exped. Akad. Wiss. Südbras. 8. 1906; Denkschr. Akad. Wiss. Math. Naturw. (Wien) 79:69. 1908.
Syntherisma digitata Hitchc. Contr. U. S. Nat. Herb. 12:142. 1908.
Digitaria digitata Urban, Symb. Antill. 8:24. 1920. Not *D. digitata* Buse, 1854.

Similar in habit, size, and pubescence to *D. sanguinalis,* the blades usually more densely pilose; racemes slender, approximate on a short axis rather than digitate, the rachis 0.4 mm. wide, very narrowly winged, with a few scattered, spreading, long white hairs; spikelets 2 mm. long; first glume minute or wanting; second glume about half as long as the fruit, sparsely villous at the tip; sterile lemma subglabrous or sparsely pilose or villous on the margins, the hairs short.

A common weed in cultivated ground and waste places in tropical and subtropical regions. More frequent than *D. sanguinalis* in the Tropics.

BOCAS DEL TORO: Isla Colón, *von Wedel 1359.* CANAL ZONE: Toro Point, *Hitchcock 8058;* Monte Lirio, *Maxon 6844;* Obispo, *Standley 31776;* Las Cascadas Plantation, *Standley 29548;* Empire to Mandinga, *Piper 5239;* Culebra, *Hitchcock 7916;* Summit, *Standley 30124.* PANAMÁ: Juan Díaz, *Standley 30620;* Pacora, *Killip 4240;* Chepo, *Pittier 4693;* Point Chamé, *Hitchcock 8163;* Taboga Island, *Hitchcock 8078; Standley 27954.*

3. DIGITARIA LANUGINOSA (Nees) Henr. Med. Rijks Herb. Leiden 61:5. 1930.

Paspalum lanuginosum Nees, Agrost. Bras. 63. 1829.
Panicum cuyabense Trin. Mém. Acad. St. Pétersb. VI. Sci. Nat. 1:206. 1834.
Digitaria cuiabense Parodi, Physis 8:378. 1926.

Straggling annual, resembling *Digitaria horizontalis;* culms as much as 1.5 m. long; sheaths villous, or the upper ones glabrous; blades flat, lax, 5–20 cm. long, 2–5 mm. wide, softly pubescent; racemes 2–6, 5–14 cm. long, ascending, racemose on a short axis; rachis angular, scabrous, wingless; spikelets paired, 3 mm. long,

one pedicel about 1 mm. long, the other about 3 mm. long; first glume wanting; second glume and sterile lemma equal, acuminate, pointed beyond the fruit, sparsely pubescent on the margins.

Along ditches and in brushy places, Panama to Bolivia and Argentina.

CHIRIQUÍ: El Boquete, *Hitchcock 8245, 8262.*

4. DIGITARIA **hirsuta** Swallen, sp. nov.

Annua; culmi erecti, ca. 50 cm. alti. glabri; vaginae internodiis longiores, dense papilloso-pilosae; ligula truncata, ca. 1 mm. longa; laminae 6–20 cm. longae, 3–4 mm. latae, planae, acuminatae, dense hirsutae; racemi 3–5, 10.5–13 cm. longi, racemosi, anguste adscendentes, rachi 0.4 mm. lata, sparse pilosa; spiculae 1.8 mm. longae; gluma prima obsoleta; gluma secunda angusta, fructu 2/3–3/4 brevior; lemma sterile fructu vix longius, acutum, 5-nerve, marginibus pubescentibus; fructus 1.7 mm. longus, ellipticus, subacutus, fuscus.

Annual; culms erect, about 50 cm. high, glabrous; sheaths all longer than the internodes, rounded or keeled toward the summit, densely papillose-pilose; ligule truncate, about 1 mm. long; blades 6–20 cm. long, 3–4 mm. wide, flat, acuminate, densely hirsute; racemes 3–5, 10.5–13 cm. long, racemose on a short pilose axis, densely villous in the axils, narrowly ascending, somewhat curved, the rachis 0.4 mm. wide, wingless, sparsely pilose with long pale hairs, the angles very scabrous; spikelets in groups of 2 to 5, the scabrous pedicels of varying length, one or two very short, the rest successively longer, some as much as 4 mm. long; spikelets 1.8 mm. long; first glume obsolete; second glume narrow, two-thirds to three-fourths as long as the fruit; sterile lemma slightly longer than the fruit, elliptic, acute, 5-nerved, the nerves rather prominent, pubescent on the margins, otherwise glabrous or nearly so; fruit 1.7 mm. long, narrowly elliptic, acutish, chestnut-brown.

Open sandy ground and brushy slopes, Panama.

CANAL ZONE: Balboa, *Standley 26444.* This specimen has shorter racemes than the type, 2–5 cm. long. PANAMÁ: Point Chamé, sandy field, Sept. 18, 1911, *Hitchcock 8159* (U. S. Nat. Herb., TYPE).

5. DIGITARIA ARGILLACEA (Hitchc. & Chase) Fernald, Rhodora 22:104. 1920.

Syntherisma argillacea Hitchc. & Chase, Contr. U. S. Nat. Herb. 18:296. 1917.

Annual; culms 5–35 cm. high, in small dense tufts, erect or somewhat geniculate at the base, rather freely branching from the lower nodes; leaves almost all crowded toward the base; sheaths keeled at least toward the summit, short but longer than the short internodes, or the uppermost elongate; ligule truncate, less than 1 mm. long; blades 2–5 cm. long, 2–3.5 mm. wide, flat, acuminate, sparsely to rather densely pilose or hirsute; racemes 1–4, 1–5 cm. long, stiffly ascending, racemose on a short axis, the rachis wingless; spikelets 2 mm. long, in pairs, one sessile, the other pedicellate; first glume obsolete; second glume and sterile lemma nearly equal, about as long as the fruit, villous with golden hairs which extend in a tuft beyond the tip of the spikelet.

Savannas, rocky or brushy slopes, and waste places, Mexico to Panama; West Indies.

COCLÉ: Aguadulce, *Pittier 4859.* PANAMÁ: Panamá, *Hitchcock 8404.*

6. DIGITARIA SINGULARIS Mez, Bot. Jahrb. (Engler) 56: Beibl. 125:8. 1921.

Slender erect perennial; culms 30–60 cm. high, glabrous, or the nodes sometimes pubescent; sheaths pilose or hirsute with spreading hairs, usually elongate, longer or shorter than the internodes; ligule brown, truncate, about 1 mm. long; blades elongate, 2–3 mm. wide, glabrous or with a few scattered hairs; racemes 1–3, long-exserted, 2.5–7 cm. long, appressed; rachis very narrowly winged; spikelets 2 mm. long, acute, paired or three together, the pedicels rounded, scabrous; first glume obsolete; second glume and sterile lemma glandular-pubescent, the glume a little shorter, the lemma slightly longer than the chestnut or blackish-brown fruits.

Savannas, Panama; Paraguay.

CANAL ZONE: between Panamá and Corozal, *Hitchcock 9196.* PANAMÁ: Chorrera, *Hitchcock 8149.*

7. DIGITARIA CURTIGLUMA Hitchc. Proc. Biol. Soc. Washington 40:84. 1927.

Perennial; culms in large dense clumps, slender, especially toward the base, 1–1.5 m. high; sheaths usually shorter than the internodes, glabrous; ligule very short; blades linear, as much as 40 cm. long, 4–7 mm. wide, flat, glabrous, or sparsely pilose on the upper surface near the base; racemes 4–5, 12–15 cm. long, appressed or very narrowly ascending, the rachis narrowly winged, about 0.7 mm. wide, scabrous; spikelets 2.3 mm. long, paired, one short-pedicellate, the other with a pedicel as long as or somewhat longer than the spikelet; first glume wanting or present as a very short thin scale; second glume about one-fourth as long as the fruit, obtuse, sometimes shallowly lobed, glabrous; sterile lemma elliptic, acute, 5-nerved, the lateral nerves approximate near the margins, minutely pubescent on the internerves; fruit dark reddish-brown, striate.

Open cut-over hillsides, Panama.

CHIRIQUÍ: El Boquete, *Hitchcock 8176* (TYPE).

45. STENOTAPHRUM Trin.

STENOTAPHRUM Trin. Fund. Agrost. 175. 1820.

Spikelets sessile or subsessile, solitary in two rows on one side of a flattened rachis, the racemes reduced to 1–3 spikelets, the rachis produced beyond the upper spikelet, the prolongation about as long as the spikelet, the short racemes inbedded (in our species) on one side of a thickened corky axis; first glume about one-fourth as long as the spikelet; second glume and sterile lemma equal, pointed beyond the fruit, acuminate, 5-nerved, the lemma enclosing a palea or staminate flower; fruit acute, chartaceous, the margins of the lemma thin, not inrolled.

Coarse, wiry, branching, stoloniferous perennial with flat obtuse blades, and solitary terminal and axillary, thickened false racemes.

1. Stenotaphrum secundatum (Walt.) Kuntze, Rev. Gen. Pl. 2:794. 1891.

Ischaemum secundatum Walt. Fl. Carol. 249. 1788.
Rottboellia stolonifera Poir. in Lam. Encycl. 6:310. 1804.
Stenotaphrum americanum Schrank, Pl. Rar. Hort. Monac. *pl. 98*. 1822.
Stenotaphrum sarmentosum Nees, Agrost. Bras. 93. 1829.
Diastemantha platystachys Steud. Syn. Pl. Glum. 1:360. 1854.
Stenotaphrum glabrum var. *americanum* Doell in Mart. Fl. Bras. 2^2:300. 1877.
Stenotaphrum dimidiatum var. *americanum* Hack. in Stuck. Anal. Mus. Nac. Buenos Aires 21:57. 1911.
Stenotaphrum dimidiatum var. *secundum* [*secundatum*] Domin, Bibl. Bot. 85:332. 1915.
Stenotaphrum secundatum var. *variegatum* Hitchc. in Bailey, Stand. Cycl. Hort. 6:3237. 1917.

Coarse tough wiry stoloniferous perennial; culms compressed, erect from the usually arching stolons, 5–50 cm. high, long internodes alternate with a series of very short ones, making the leaves in groups; sheaths broad, compressed, keeled, glabrous, sometimes ciliate on the margins, with a small tuft of hairs in the throat; blades flat, conduplicate, obtuse, 2–15 cm. long, as much as 15 mm. wide unfolded, glabrous, the margins scabrous at the tip; racemes terminal on the main culm and short branches from the upper nodes, mostly 4–10 cm. long, straight or curved, the thick rachis 3–4 mm. wide; spikelets 4–6 mm. long, acuminate, glabrous, the first glume obtuse, one-third to half as long as the spikelet.

Sea-shores and sandy ground, southern United States and the West Indies to Argentina; Africa, Hawaii, Pacific Islands, and Australia.

BOCAS DEL TORO: Laguna de Chiriquí, *Hart 183*. COLÓN: Viento Frio, *Pittier 4115*; Río Indio de Fató, *Pittier*. CANAL ZONE: Chagres, *Fendler 362*.

46. THRASYA H.B.K.

Thrasya H.B.K. Nov. Gen. & Sp. 1:120. *pl. 39*. 1815.

Spikelets in pairs in two rows on one side of a narrow- to broad-winged rachis, turned back to back, the first subsessile, the second pedicellate, the pedicel adnate to the rachis, the spikelets thus appearing solitary; first glume small, sometimes hyaline; second glume usually shorter than the fruit, acute; sterile lemma indurate, sulcate and often splitting down the middle at maturity, enclosing a well-developed palea and usually a staminate flower; fruit indurate, striate, with a few stiff hairs at the tip, the margins narrow, firm, not inrolled.

Branching perennials with narrow flat blades and solitary, terminal and axillary, straight or usually curved racemes.

a. Rachis broadly winged, 3–4 mm. wide; culms rather coarse, 1–1.5 m. high; spikelets 4 mm. long ..... 1. T. petrosa
aa. Rachis 1–2 mm. wide; culms not more than 90 cm. high, usually less; spikelets 2.2–3.5 mm. long.
b. Racemes 8–20 cm. long; rachis 1.5–2 mm. wide; culms 70–90 cm. high.
c. Spikelets 3.5 mm. long, the second glume and sterile lemma sparsely pilose on the margins; rachis 2 mm. wide; blades pubescent on both surfaces ..... 2. T. hitchcockii
cc. Spikelets 2.8 mm. long, glabrous; rachis 1.5 mm. wide; blades glabrous or scabrous, prominently papillose-hispid-ciliate ..... 3. T. ciliatifolia

bb. Racemes 2–5 cm. long; rachis 0.5–1 mm. wide; culms not more than 50 cm. high.
c. Sheaths and blades glabrous or more or less papillose-hirsute; spikelets 2.2 mm. long, glabrous ..... 4. T. GRACILIS
cc. Sheaths and blades densely and softly villous; spikelets 2.5 mm. long, densely villous ..... 5. T. VILLOSA

1. THRASYA PETROSA (Trin.) Chase, Proc. Biol. Soc. Washington 24:115. 1911.

Panicum petrosum Trin. Gram. Icon. 3: *pl. 280.* 1831.
Tylothrasya petrosa Doell in Mart. Fl. Bras. 2^2:295. *pl. 37.* 1877.

Perennial; culms tufted, erect, 1–1.5 m. high, appressed papillose-pilose, the nodes bearded; sheaths keeled, elongate, mostly longer than the internodes, glabrous to densely papillose-pilose, especially toward the summit; ligule brown, truncate, about 1 mm. long; blades elongate, mostly 4–6 mm. wide, acuminate or sometimes attenuate, narrowed toward the base, glabrous to more or less papillose or papillose-hirsute, the uppermost wanting or very much reduced; racemes 15–20 cm. long, curved, on long slender peduncles, the rachis winged, 3–4 mm. wide; spikelets 4 mm. long, villous; first glume minute; second glume longer than the fruit, acuminate; sterile lemma slightly shorter than the second glume, acute, sulcate, slightly divided at the summit, the palea prominent, nearly as long as the lemma; fertile lemma 3.5 mm. long, narrowly ovate, pale, minutely striate, subacute.

Dry grassy hills and savannas at lower altitudes, Guatemala; Panama to Peru, Brazil, and Paraguay.

CHIRIQUÍ: Dolega, *Hitchcock 8344.* CANAL ZONE: between Panamá and Corozal, *Hitchcock 9193;* Ancón Hill, *Killip 4122.* PANAMÁ: Chorrera, *Hitchcock 8140½;* Taboga Island, *Hitchcock 8092.*

2. THRASYA HITCHCOCKII Chase, Jour. Washington Acad. Sci. 17:142. 1927.

Perennial; culms tufted, erect or ascending, about 70 cm. high, flattened, sparsely to densely papillose-pilose, the lower nodes appressed-pubescent; sheaths keeled, papillose-hirsute to nearly glabrous, the margins densely ciliate; ligule brown, truncate, about 1 mm. long; blades 15–30 cm. long, 5–6 mm. wide, the uppermost reduced or obsolete, pubescent on both surfaces and also sparsely hirsute with longer hairs, the margins rather prominently hispid-ciliate; racemes terminal and axillary, 10–20 cm. long, arcuate, long-exserted, the rachis 2 mm. wide, glabrous, with a few long hairs on the margins; spikelets 3.5 mm. long, oblong-elliptic; first glume minute or obsolete, occasionally acuminate, as much as 2 mm. long; second glume and sterile lemma equal, exceeding the fruit, the glume evidently 5-nerved, pilose on the margins, the lemma indurate, subacute, glabrous or with a few hairs on the margins; fruit 3 mm. long, pale, striate-roughened, with a few stiff hairs at the summit of the lemma.

Wood borders, Panama and Venezuela.

PANAMÁ: Chorrera, *Hitchcock 8140* (TYPE).

3. THRASYA **ciliatifolia** Swallen, sp. nov.

Perennis; culmi 80–90 cm. alti, erecti, pauciramosi, glabri, nodiis inferioribus pubescentibus; vaginae elongatae, glabrae vel sparse papilloso-hirsutae, marginibus

ciliatis; ligula 1 mm. longa; laminae 15–20 cm. longae, 3–5 mm. latae, marginibus hispido-ciliatis; racemi 8–13 cm. longi, arcuati, rachi sparse ciliata; spiculae 2.8 mm. longae, glabrae; gluma prima 1.5 mm. longa, acuminata; gluma secunda abrupte acuta; lemma sterile saepe induratum lemmate fertili vix longius; fructus oblongus, subacutus, striatus.

Perennial; culms 80–90 cm. high, erect, sparingly branching, glabrous, the lower nodes appressed-pubescent; sheaths elongate, keeled toward the summit, glabrous or sparsely papillose-hirsute, the margins ciliate; ligule brown, about 1 mm. long; blades 15–20 cm. long, 3–5 mm. wide, the margins scabrous and prominently papillose-hispid-ciliate, the uppermost blade very much reduced (about 1 cm. long), sometimes wanting; raceme 8–13 cm. long, arcuate, short- or long-exserted, the rachis 1.5 mm. wide, ciliate with long hairs, the hairs sometimes rather sparse; spikelets 2.8 mm. long, glabrous; first glume 1.5 mm. long, acuminate, sometimes short and blunt; second glume nearly as long as the fruit, abruptly acute; sterile lemma usually indurate, acute, often sulcate, slightly longer than the fruit; fruit oblong, subacute, minutely striate-roughened.

Savannas, Panama.

CANAL ZONE: abundant on prairie between Pedro Miguel and Corozal, 20–50 m. alt., *Hitchcock 7988½* (U. S. Nat. Herb., TYPE).

4. THRASYA **gracilis** Swallen, sp. nov.

Perennis; culmi 15–50 cm. alti, graciles, erecti, glabri, nodiis inferioribus aliquando pubescentibus; vaginae angustae, glabrae, marginibus ciliatis, suprema elongata; ligula tenuis, 1–2 mm. longa; laminae 6–10 cm. longae, 2–3 mm. latae, glabrae, marginibus papilloso-hispido-ciliatis; racemi 2–3.5 cm. longi, rachi alata, ca. 1 mm. lata; spiculae 2.2 mm. longae, glabrae; gluma prima acuta, ca. 1 mm. longa; gluma secunda abrupte acuta, 1.7 mm. longa, fructu angustior; lemma sterile fructum subaequans; fructus obovatus, acutus, pallens.

Perennial; culms 15–50 cm. high, very slender, erect, glabrous, the lower nodes sometimes pubescent; sheaths narrow, glabrous, ciliate on the margins, the lower ones short but longer than the internodes, the upper one elongate; ligule thin, brownish, 1–2 mm. long; blades 6–10 cm. long, 2–3 mm. wide, the uppermost much reduced, glabrous or more or less papillose-hirsute, the margins prominently papillose-hispid-ciliate; raceme 2–3.5 cm. long, exserted on a long very slender peduncle, the rachis winged, about 1 mm. wide; spikelets 2.2 mm. long, glabrous; first glume acute, about 1 mm. long, the second abruptly acute, 1.7 mm. long, narrower than the fruit; sterile lemma equal to or very slightly longer than the fruit, acute; fruit slightly obovate, acute, pale.

Savannas, Panama.

CHIRIQUÍ: Cerro Vaca, in savannas 900–1130 m. alt., *Pittier 5365* (U. S. Nat. Herb., TYPE).

5. THRASYA VILLOSA Hitchc. Proc. Biol. Soc. Washington 40:84. 1927.

Perennial; culms erect, freely branching, 10–30 cm. high, densely villous;

sheaths villous; ligule obtuse, less than 1 mm. long; blades 5–10 cm. long, 2–4 mm. wide, flat, villous or velvety-pubescent; racemes terminal and axillary, 2–5 cm. long, slightly curved, the peduncles rather stout, densely villous, the rachis less than 0.5 mm. wide, villous with long and short hairs intermixed; spikelets about 2.5 mm. long, densely pubescent; first glume minute or obsolete; second glume narrower than the fruit and somewhat shorter; sterile lemma as long as the fruit, concave between the lateral nerves; fertile lemma whitish, appressed-hirsute, acutish.

Savannas, Panama.

CHIRIQUÍ: Cerro Vaca, *Pittier 5363* (TYPE).

47. PSEUDECHINOLAENA Stapf

PSEUDECHINOLAENA Stapf in Prain, Fl. Trop. Afr. 9:494. 1919.

Spikelets solitary, sometimes an abortive spikelet below it, pedicellate, rather distant, in two rows on one side of a slender raceme; first glume a little shorter than the spikelet, acute or mucronate, 3- to 5-nerved; second glume a little longer than the first, acuminate, saccate, 5-nerved, at maturity covered with stiff hooked bristles; sterile lemma about as long as the second glume, somewhat indurate, broad, obtuse, with thin margins, glabrous; fruit narrow, subacuminate, smooth and shining, the margins rather broad, not inrolled.

Slender decumbent-spreading annuals with short, broad, flat blades, and short slender racemes distant on the common axis.

1. PSEUDECHINOLAENA POLYSTACHYA (H.B.K.) Stapf in Prain, Fl. Trop. Afr. 9:495. 1919.

Echinolaena polystachya H.B.K. Nov. Gen. & Sp. 1:119. 1815.
Panicum uncinatum Raddi, Agrost. Bras. 41. 1823.

Slender decumbent-spreading annual; culms 15 cm. to as much as 1 m. high, branching, rooting at the lower nodes, more or less pilose; sheaths mostly much shorter than the internodes, rather densely papillose-pilose or hirsute, especially toward the summit; ligule brown, about 1 mm. long; blades ovate-lanceolate, often unsymmetrical, 2–7 cm. long, 5–16 mm. wide, thin, acuminate-pointed, appressed-pilose on both surfaces; inflorescence 5–20 cm. long, the axis pilose, the slender distant racemes usually narrowly ascending; spikelets 3–4 mm. long, appressed or somewhat spreading, the pedicels 1–3 mm. long; first glume broad, acute, pubescent, a little shorter than the spikelet; second glume longer than the first, sparsely to densely covered with coarse hooked bristles; fruit about 2 mm. long, acute, smooth and shining.

Wet forests, moist brushy slopes, stream margins, and open cultivated ground, Mexico to Bolivia and Paraguay; tropical Africa.

CHIRIQUÍ: El Boquete, *Hitchcock 8179, 8301; Maxon 5006;* Finca Lérida to Boquete, *Woodson, Allen & Seibert 1167.*

48. MESOSETUM Steud.

MESOSETUM Steud. Syn. Pl. Glum. 1:118. 1854.

Spikelets sessile or very shortly pedicellate, in two rows on one side of the flattened rachis, the first glume turned toward, hence the back of the fruit turned away from the rachis; first glume more than two-thirds as long as the spikelet, 3- to 5-nerved; second glume and sterile lemma equal, exceeding the fruit; fertile lemma acute, minutely striate or roughened, the margins flat, but tightly enclosing the palea.

Annual grasses (in our species) with flat narrow blades and solitary, thick, erect racemes.

1. MESOSETUM PITTIERI Hitchc. Proc. Biol. Soc. Washington 40:85. 1927.

Fig. 19. *Mesosetum pittieri*

Annual; culms spreading, 10–30 cm. long; nodes hispidulous; blades flat, distantly setulose on the thickened margin, sparingly pilose near the base, 2–5 cm. long, 3–4 mm. wide; raceme 2–4 cm. long; spikelets about 5 mm. long; first glume a little shorter than the equal second glume and sterile lemma, laterally compressed, narrowed to the middle and then widened to a rounded crest-like tip, pilose on the lower part of the keel; second glume laterally compressed above, narrowed to a crest-like acute tip, pilose at the base, sparingly villous on the lower half of the back, 5-nerved, cross-ridged toward the apex; sterile lemma similar to the second glume, the crested tip less acute; fertile lemma acute, shorter than the second glume.

Savannas at low altitudes, Panama.

COCLÉ: Natá, *Allen 839*. PANAMÁ: Chepo, *Pittier 4516, 4687, 4751* (TYPE).

49. ERIOCHLOA H.B.K.

ERIOCHLOA H.B.K. Nov. Gen. & Sp. 1:94. 1815.

Spikelets usually in pairs, arranged in two rows on one side of a slender rachis, the back of the fruit turned away from the rachis; first glume united with the thickened first segment of the rachilla, forming a ring-like callus below the second glume; second glume and sterile lemma equal or nearly so, acute or acuminate, 3-nerved; fruit much shorter than the second glume and sterile lemma (in our species), elliptic, awnless or short-awned, minutely striate and cross-wrinkled or

papillose-roughened, the margins of the lemma firm, inrolled, rather tightly enclosing the palea.

Annuals or perennials with flat blades and terminal inflorescences composed of 2 to many one-sided racemes racemose on a common axis.

a. Racemes 1 or 2, 1–2 cm. long, densely villous; fruit 2.4 mm. long, awnless ..... 1. E. DISTACHYA
aa. Racemes many, the lower ones usually 4–5 cm. long, not villous, appressed; fruit 2 mm. long, with a hispidulous awn about 1 mm. long ..... 2. E. PUNCTATA

1. ERIOCHLOA DISTACHYA H.B.K. Nov. Gen. & Sp. 1:95. *pl. 30.* 1815.

Low freely branching perennial; culms 10-40 cm. high, slender, erect or geniculate-ascending, densely pubescent below the inflorescence, the nodes bearded, otherwise glabrous; sheaths glabrous or sparsely pilose, with a small tuft of hairs in the throat; ligule densely ciliate, less than 0.5 mm. long; blades 3–15 cm. long, 2–5 mm. wide, flat, acuminate, erect, glabrous, or sparsely pilose on the upper surface, the margins finely scabrous; inflorescence long-exserted, composed of 1 or 2 divergent distant, short racemes; racemes 1–2 cm. long, straight or somewhat curved, densely villous; spikelets 3 mm. long, pectinate, the pedicels with long hairs at the summit; second glume and sterile lemma bluntly acute, densely villous with appressed hairs; fruit 2.4 mm. long, oblong, blunt, pale, awnless, with a few long hairs at the tip.

Savannas at low altitudes, Guatemala to Paraguay.

COCLÉ: Olá, *Pittier 5043.* PANAMÁ: between Las Sabanas and Matías Hernández, *Standley 31861;* Río Tecúmen, *Standley 26613, 29398;* Río Chico, *Killip 4228.*

Known as "cepillito montañoso" in Panama.

2. ERIOCHLOA PUNCTATA (L.) Desv. ex Hamilt. Prodr. Pl. Ind. Occ. 5. 1825.
Milium punctatum L. Syst. Nat. ed. 10. 2:872. 1759.
Agrostis punctata Lam. Encycl. 1:58. 1783.
Oedipachne punctata Link, Hort. Berol. 1:51. 1827.
Helopus punctatus Nees, Agrost. Bras. 16. 1829.
Monachne punctata Nash, Bull. Torrey Club 30:374. 1903.

Glabrous, rather freely branching perennial; culms erect or ascending from a decumbent base, commonly more than 1 m. high, densely pilose below the inflorescence; sheaths rounded, usually much shorter than the internodes, the prophylla, in those subtending the branches, often elongate and conspicuous; ligule densely ciliate, about 0.5 mm. long; blades 15–40 cm. long, 5–15 mm. wide, acuminate, the margins finely scabrous; inflorescence 10–20 cm. long, the axis and the rachis of the narrowly ascending racemes densely pubescent and also pilose; racemes many, ascending or appressed, the lower ones 4–5 cm. long; spikelets 4 mm. long; second glume and sterile lemma equal, acuminate, densely pilose on the lower part with long appressed white hairs, the upper portion glabrous; fruit about 2 mm. long, the hispidulous awn about 1 mm. long.

Swamps, ditches, and wet places, southern United States and the West Indies to Argentina.

BOCAS DEL TORO: Laguna de Chiriquí, *Hart 64.*

50. BRACHIARIA Griseb.

Brachiaria Griseb. in Ledeb. Fl. Ross. 4:469. 1853.

Spikelets solitary, subsessile in two rows on one side of a flattened or triangular rachis, the first glume turned toward the rachis; first glume 3- to 5-nerved, broad and clasping, one-third to half as long as the spikelet; second glume and sterile lemma equal, longer than the fruit, 5- to 7-nerved, glabrous or pubescent; fruit indurate, usually papillose-rugose, sometimes smooth, the margins of the lemma inrolled.

Annual or perennial, stoloniferous or decumbent-spreading grasses with flat blades and few to several racemes approximate or rather distant on a common axis.

1. Brachiaria plantaginea (Link) Hitchc. Contr. U. S. Nat. Herb. 12:212. 1909.

Panicum plantagineum Link, Hort. Berol. 1:206. 1827.
Panicum leandri Trin. Gram. Icon. 3: *pl. 335.* 1836.
Panicum distans Salzm. ex Steud. Syn. Pl. Glum. 1:61. 1854. Not *P. distans* Trin., 1829.
Panicum disciferum Fourn. Mex. Pl. 2:19. 1886.

Annual; culms decumbent-spreading, rooting at the nodes, the ascending ends and flowering branches commonly 20–30 cm. high; sheaths compressed, keeled, glabrous, usually ciliate on the margins; ligule ciliate, about 1 mm. long; blades 5–20 cm. long, 8–12 mm. wide, rather lax, rounded at the base, the margins scabrous, sparsely ciliate near the base; racemes usually 3–6, or sometimes 1 or 2 on the branches, 3–10 cm. long, rather distant, ascending to spreading, the rachis 1–1.5 mm. wide; spikelets 4–4.7 mm. long, acute, glabrous; fruit 3–3.5 mm. long, plano-convex, subobtuse, minutely striate and papillose-roughened.

Moist open ground, Mexico to Bolivia and Brazil. Introduced in the United States.

Panamá: La Jagua, *Bartlett & Lasser 16985.*

51. AXONOPUS Beauv.

Axonopus Beauv. Ess. Agrost. 12, 154. 1812.

Spikelets solitary, sessile in two rows on one side of the 3-angled rachis, the back of the fruit turned from the rachis; first glume wanting; second glume and sterile lemma equal, often pointed beyond the fruit; fertile lemma and palea indurate, the lemma oblong-elliptic, the margins slightly inrolled.

Cespitose or stoloniferous perennials, or rarely annuals, with flat or folded, rounded or pointed blades, and few to many slender racemes, digitate or racemose on the common axis.

a. Rachis conspicuously hispid with stiffly spreading golden-yellow hairs.
  b. Rachis winged, 1–2 mm. wide, extended beyond the spikelets, these sunken in hollows of the rachis.
    c. Plants perennial; sheaths papillose-hispid; inflorescences terminal on the main culm and branches ..... 2. A. chrysoblepharis
    cc. Plants annual; sheaths glabrous; inflorescences terminal and axillary ..... 3. A. appendiculatus

bb. Rachis wingless, 0.4–0.7 mm. wide, not extending beyond the spikelets, these not sunken in hollows of the rachis. Plants perennial.... 1. A. AUREUS
aa. Rachis glabrous or scabrous.
b. Plants annual. Spikelets about 1.3 mm. long.... 4. A. CAPILLARIS
bb. Plants perennial.
c. Spikelets 3–3.5 mm. long.
d. Blades conspicuously conduplicate, linear, the margins parallel. Fruit with a short tuft of hairs at the tip.... 9. A. CAESPITOSUS
dd. Blades flat or folded only at the base, narrowed toward both ends.
e. Second glume and sterile lemma extending well beyond the fruit, the lemma pubescent between the nerves; racemes 2–6 on a relatively short axis; plants cespitose, not stoloniferous 10. A. CENTRALIS
ee. Second glume and sterile lemma scarcely longer than the fruit, glabrous or nearly so; racemes several to numerous in a rather dense inflorescence, as much as 40 cm. long; plants stoloniferous.... 6. A. SCOPARIUS
cc. Spikelets 1.7–2.5 mm. long (rarely 3 mm. long in *A. compressus*).
d. Spikelets 1.7–1.8 mm. long, glabrous; blades sparsely ciliate with long hairs.... 7. A. ATER
dd. Spikelets 2–2.5 mm. long, pubescent.
e. Blades 1–4 mm. wide, densely pubescent on the upper surface toward the base; plants densely cespitose, sometimes tardily stoloniferous; spikelets with a rather prominent tuft of stiff hairs at the tip.... 8. A. PURPUSII
ee. Blades 6–10 mm. wide, glabrous; plants freely stoloniferous; spikelets sparsely pubescent on the internerves.... 5. A. COMPRESSUS

1. AXONOPUS AUREUS Beauv. Ess. Agrost. 12, 154. 1812.

Paspalum aureum H.B.K. Nov. Gen. & Sp. 1:93. 1815.
Digitaria aurea Spreng. Syst. Veg. 1:272. 1825.
Paspalum pulchrum Nees, Agrost. Bras. 79. 1829.
Paspalum exasperatum Nees, Agrost. Bras. 81. 1829.
Paspalum pulchrum var. *angustifolium* Doell in Mart. Fl. Bras. 2^2:116. 1877.
Paspalum carinato-vaginatum Mez, Repert. Sp. Nov. (Fedde) 15:31. 1917.
Axonopus pulcher Kuhlm. Comm. Linhas Telegr. Estrat. Matto Grosso 67:88. 1922.

Perennial; culms 35–90 cm. high, rarely more than 1 m., erect, branching; sheaths compressed, keeled, glabrous, the margins sometimes ciliate; ligule ciliate, about 0.5 mm. long; blades 4–15 cm. long, 3–9 mm. wide, spreading, firm, flat or drying involute toward the tip, glabrous, the margins scabrous, sometimes sparsely ciliate toward the rounded base; racemes 2–15, slender, ascending, crowded on a short hairy axis; rachis 0.4–0.7 mm. wide, conspicuously papillose-ciliate with stiff golden-yellow or brown hairs, bearing below each spikelet a tuft of similar hairs; spikelets 1.3 mm. long, glabrous or sparsely appressed-hispid.

Wet sandy savannas, Puerto Rico and Trinidad; British Honduras to Brazil and Bolivia.

CHIRIQUÍ: Cerro Vaca, *Pittier 5367;* San Felix, *Pittier 5232.* COCLÉ: Natá, *Allen 846;* El Valle de Antón, *Allen 2822.* CANAL ZONE: Río Azote Caballo, *Dodge, Steyermark & Allen 16859;* Corozal, *Hitchcock 7987;* Ancón Hill, *Killip 4067.* PANAMÁ: Taboga Island, *Macbride 2837; Standley 28007.*

2. AXONOPUS CHRYSOBLEPHARIS (Lag.) Chase, Proc. Biol. Soc. Washington 24:134. 1911.

Cabrera chrysoblepharis Lag. Gen. & Sp. Nov. 5. 1816.
Paspalum excavatum Nees ex Trin. Gram. Pan. 88. 1826.

Paspalum immersum Nees, Agrost. Bras. 82. 1829.
Panicum immersum Trin. Mém. Acad. St. Pétersb. VI. Sci. Nat. 1:197. 1834.
Panicum chrysoblephare Steud. Syn. Pl. Glum. 1:38. 1854.
Paspalum chrysoblephare Doell in Mart. Fl. Bras. 2^2:119. 1877.

Perennial; culms 60–100 cm. high, slender to rather stout, erect or ascending, branching from the middle nodes, straw-colored or brown, smooth and shining, the nodes densely bearded with golden-yellow hairs; sheaths much shorter than the internodes, keeled but scarcely compressed, densely papillose-hispid with spreading hairs; ligule a short ciliate membrane about 0.2 mm. long; blades 8–25 cm. long, 5–12 mm. wide, acuminate, narrowed toward the scarcely rounded base, nearly glabrous to pilose or papillose-pilose, the margins smooth or sometimes papillose-hispid-ciliate; racemes 4–7, stiffly and usually narrowly ascending, crowded on a short rather stout axis, 4–10 cm. long; rachis 1.2–1.5 mm. wide, extending beyond the spikelets, the margins and ridge separating the two rows of spikelets prominently hispid or papillose-hispid with stiff golden-yellow hairs; spikelets about 1.5 mm. long, obtuse, deeply sunken in the cavities of the rachis.

Savannas and grassy slopes, Costa Rica to Bolivia and Paraguay.

CANAL ZONE: Ancón Hill, *Standley 25199.* PANAMÁ: Hacienda La Joya, *Dodge, Hunter, Steyermark & Allen 16892.* Without locality, *Née* (TYPE).

3. AXONOPUS APPENDICULATUS (Presl) Hitchc. & Chase, Contr. U. S. Nat. Herb. 18:300. 1917.

Paspalum appendiculatum Presl, Rel. Haenk. 1:211. 1830.

Annual; culms 25–60 cm. high, slender, erect, compressed, sparingly branched, straw-colored, smooth and shining; sheaths mostly much shorter than the internodes, compressed, glabrous; ligule about 0.3 mm. long, densely ciliate; blades 5–15 cm. long, 4–10 mm. wide, thin, flat, acuminate, rounded at the base, glabrous or rarely sparsely papillose, the margins finely scabrous and sometimes sparsely papillose-hispid; racemes 2–8, stiffly ascending to arcuate-spreading, 2–4 cm. long, approximate on a short stout angular axis; rachis about 1.2 mm. wide, prolonged beyond the spikelets but often terminated with a rudimentary spikelet, the margins and ridge separating the two rows of spikelets prominently and densely papillose-hispid with yellow or golden hairs, the papillae exceptionally large; spikelets 1.2–1.3 mm. long, somewhat pointed, glabrous, sunken in rather deep cavities of the rachis.

Savannas, thickets, and grassy slopes, often in moist ground, Trinidad, Panama, and northeastern Brazil.

COCLÉ: between Paso del Arado and Olá, *Pittier 5021;* Olá, *Pittier 5052.* Without locality, *Haenke* (TYPE).

4. AXONOPUS CAPILLARIS (Lam.) Chase, Proc. Biol. Soc. Washington 24:133. 1911.

Paspalum capillare Lam. Tabl. Encycl. 1:176. 1791.
Panicum minutum Trin. Linnaea 10:293. 1836.
Anastrophus capillaris Nash, N. Amer. Fl. 17:161. 1912.

Annual; culms 10–30 cm., or sometimes as much as 50 cm., high, very slender, erect or ascending, sometimes geniculate-spreading, branching at the lower nodes, glabrous; sheaths keeled, glabrous or usually pilose, the margins rather densely ciliate, the lower ones crowded, usually longer than the internodes, the upper elongate; blades 2.5–15 cm. long, 4–10 mm. wide, thin, glabrous, the margins more or less ciliate toward the rounded or subcordate base; inflorescences long-exserted on slender peduncles, terminal and axillary from the upper sheath; racemes mostly 2 or 3, sometimes 4 or 5, slender, ascending or spreading, the 2 upper ones conjugate, the others a short distance below, the rachis about 0.5 mm. wide, flexuous, the margins scabrous; spikelets about 1.3 mm. long, obscurely pointed, glabrous or sparingly pubescent.

Moist open ground; a weed in fields and waste places, Costa Rica and Trinidad to Brazil.

PANAMÁ: Panamá, *Gagelin 493*.

5. AXONOPUS COMPRESSUS (Swartz) Beauv. Ess. Agrost. 12. 1812.

Milium compressum Swartz, Prodr. Veg. Ind. Occ. 24. 1788.
Paspalum platicaulon Poir. in Lam. Encycl. Suppl. 5:34. 1804.
Agrostis compressa Poir. in Lam. Encycl. Suppl. 1:259. 1810. Not *A. compressa* Willd., 1790.
Paspalum compressum Raspail, Ann. Sci. Nat. 5:301. 1825.
Paspalum laticulmum Spreng. Syst. Veg. 1:245. 1825.
Digitaria platicaulis Desv. Opusc. 62. 1831.
Paspalum filostachyum A. Rich. ex Steud. Syn. Pl. Glum. 1:20. 1854.
Anastrophus compressus Schlecht. ex Doell in Mart. Fl. Bras. 2^2:102. 1877.
Paspalum raunkiaerii Mez, Repert. Sp. Nov. (Fedde) 15:60. 1917.

Stoloniferous perennial; culms in small tufts, 15–60 cm. high, compressed, erect or ascending, the nodes appressed-pubescent or sometimes bearded; stolons long, leafy, with short blades; sheaths keeled, glabrous, pubescent on the collar, the margins hyaline, glabrous or ciliate, the lower ones relatively short, much longer than the internodes, the upper one elongate; blades 5–15 cm. long, or those of the innovations elongate, 6–10 mm. wide, rarely as little as 4 mm. or as much as 12 mm. wide, obtuse, rounded at the base, glabrous, the margins usually ciliate at least toward the base; inflorescences terminal and axillary from the upper sheaths, composed of 2–5 ascending or spreading racemes, 3–9 cm. long, the upper two conjugate, the others a short distance below; spikelets 2–2.5 mm. long (rarely 3 mm.), the second glume and sterile lemma pointed beyond the fruit, glabrous or sparsely pubescent on the internerves; fruit 1.5–2 mm. long, oblong, minutely roughened.

Open ground, fields, open woods and brushy slopes, usually in moist ground, Florida and the West Indies to Argentina; also in warmer parts of the Old World.

CHIRIQUÍ: Dolega, *Hitchcock 8341*. COCLÉ: Aguadulce, *Pittier 4931*. CANAL ZONE: Barro Colorado Island, *Bailey & Bailey 497*; Gamboa, *Standley 28485*; Juan Mina, *Piper 5211*; *Bartlett & Lasser 16495*; Culebra, *Pittier 3742*; *Hitchcock 7912, 7913*; Summit, *Standley 25702*; Ancón, *Hitchcock 19892, 19893*; Ancón Hill, *Piper 5212*; Balboa, *Standley 25650, 26476*; *Piper 5214*. PANAMÁ: Chepo, *Pittier 4452, 4634*; Taboga Island, *Hitchcock 8063*; Chagres Valley, *Pittier 3462*.

6. Axonopus scoparius (Flügge) Kuhlm. Comm. Linhas Telegr. Estrat. Matto Grosso 67:45. 1922.

Paspalus scoparius Flügge, Monogr. Pasp. 124. 1810.
Paspalum iridifolium Poepp. Reise 2:324. 1836.
Panicum giganteum Kuntze, Rev. Gen. Pl. 3^3:360. 1898.
Anthaenantia gigantea Schum. in Just's Bot. Jahresb. 26^1:329. 1900.
Paspalum fournierianum var. *maximum* Thellung, Mém. Soc. Sci. (Nat.) Neuchâtel 5:344. 1913.
Paspalum tripinnatum Mez, Repert. Sp. Nov. (Fedde) 15:64. 1917.

Stout, stoloniferous perennial; culms mostly 1–2 m. high, erect, glabrous, or the nodes sometimes pubescent; sheaths mostly longer than the internodes, compressed, glabrous or sometimes pilose on the collar and margins; blades 20–60 cm. long, mostly 1–3 cm. wide, flat, glabrous, or rarely pubescent; inflorescence as much as 40 cm. long, composed of few to many ascending racemes 8–16 cm. long; spikelets 3 mm. long, glabrous or sparsely pilose, usually purple-tinged, the second glume and sterile lemma rather strongly nerved.

Hillsides and savannas, Central America to Brazil and Bolivia.

CHIRIQUÍ: Cerro Vaca, *Pittier 5369*.

7. Axonopus ater Chase, Jour. Washington Acad. Sci. 17:143. 1927.

Perennial; culms densely tufted, 40–50 cm. high, erect or ascending, simple, compressed, glabrous, the nodes densely appressed-pubescent; sheaths much shorter than the internodes, keeled, the margins ciliate or sometimes glabrous; ligule short, fimbriate; blades 4–15 cm. long, 4–5 mm. wide, stiff, folded, obtuse, scabrous at the apex, the margins scabrous, papillose-ciliate; inflorescences terminal and axillary, long-exserted; racemes 2–5, the upper two or three digitate, the others a short distance below, 4–6 cm. long, ascending to widely spreading, the rachis about 6 mm. wide, the margins scabrous, the central angle sharply raised; spikelets 1.7–1.8 mm. long, relatively distant, oblong-elliptic, abruptly pointed, the glume and sterile lemma equal, just covering the fruit, glabrous or obscurely pubescent.

Waste ground, Panama; known only from the type collection.

CANAL ZONE: Gatún, *Hitchcock 7976* (TYPE).

8. Axonopus purpusii (Mez) Chase, Jour. Washington Acad. Sci. 17:144. 1927.
Paspalum purpusii Mez, Bot. Jahrb. (Engler) 56: Beibl. 125:10. 1921.

Perennial; culms very slender, densely tufted, erect, 15–40 cm. high; leaves crowded toward the base, only one about the midculm, this with elongated sheath and reduced blade; sheaths compressed, keeled, glabrous to sparsely pilose with a dense tuft of hairs at the mouth; blades flat, conduplicate at the base, mostly 5–10 cm. long, rarely as much as 20 cm., 1–4 mm. wide, densely hairy on the upper surface toward the base, otherwise sparsely pilose or nearly glabrous; inflorescences terminal and sometimes axillary, composed of 2–4 slender ascending racemes 3–8 cm. long; spikelets 2 mm. long; second glume and sterile lemma somewhat pointed beyond the fruit, the margins stiffly appressed-pilose, the hairs longer at the summit, forming a rather prominent tuft at the tip of the spikelet.

Wet savannas and open woods, southern Mexico to Argentina.

CHIRIQUÍ: David, *Hitchcock 8362, 8368;* Dolega, *Hitchcock 8342.* CANAL ZONE: Summit, *Higgins 202;* Corozal, *Piper 5210;* Balboa, *Hitchcock 8018.* PANAMÁ: Río Tecúmen, *Standley 26504;* Chorrera, *Standley 8148½;* Panamá, *Standley 27762.*

9. AXONOPUS **caespitosus** Swallen, sp. nov.

Perennis; culmi 60–90 cm. alti, erecti, dense caespitosi, nodiis dense barbatis; vaginae inferiores approximatae, latae, compressae, carinatae, glabrae; ligula ciliata, ca. 1 mm. longa; laminae 15–40 cm. longae, 4–6 mm. latae, planae, basi conduplicatae, glabrae, marginibus dense papilloso-ciliatis; racemi 4–6, 8–14 cm. longi, anguste adscendentes; rachis flexuosa, ca. 0.4 mm. lata, scabra; spiculae 3–3.5 mm. longae; gluma secunda et lemma aequalia fructu longiora, sparse pilosa; fructus 2.5–2.8 mm. longus, oblongo-ellipticus, minute rugosus, apice pilosus.

Perennial; culms erect in large clumps, 60–90 cm. high, the nodes densely bearded with rather short ascending hairs; basal sheaths crowded, broad, subequitant, strongly compressed, keeled, glabrous, or pubescent on the collar; ligule ciliate, about 1 mm. long; blades 15–40 cm. long, 4–6 mm. wide, flat, conduplicate at the base, glabrous, the margins densely papillose-ciliate toward the base; inflorescences terminal and axillary from the upper sheath, composed of 4–6 erect or narrowly ascending racemes 8–14 cm. long; rachis triangular, flexuous, about 0.4 mm. wide, scabrous on the angles; spikelets 3–3.5 mm. long; second glume and sterile lemma thin, equal, acute, pointed beyond the fruit, sparsely pilose, the hairs longer and denser at the tip, the two lateral nerves approximate; fruit 2.5–2.8 mm. long, oblong-elliptic, very minutely rugose, with a small tuft of soft hairs at the acute tip.

Open grassy hills, Taboga Island, where it makes up a large part of the grass flora.

PANAMÁ: Taboga Island, grassy hills, forming bulk of grass, Sept. 12, 1911, *Hitchcock 8089* (U. S. Nat. Herb.,TYPE); *Pittier 3565, 3582.*

10. AXONOPUS CENTRALIS Chase, Jour. Washington Acad. Sci. 17:143. 1927.

Perennial; culms in large clumps, 40–90 cm. high, erect to stiffly spreading, simple, compressed, glabrous; sheaths keeled, usually pubescent on the margins at least toward the summit and on the collar, otherwise glabrous; ligule short, firm, fimbriate; blades 15–50 cm. long, 6–10 mm. wide, flat, or folded at the base, sparsely pubescent on the upper surface, glabrous on the lower, the margins ciliate toward the base; inflorescences terminal and axillary, finally long-exserted; racemes 2–6, 8–15 cm. long, ascending or spreading, the upper 2 or 3 approximate, the lower remote, the rachis about 0.5 mm. wide, flexuous, minutely scabrous on the margins; spikelets 3 mm. long, oblong, rather distant, the glume and sterile lemma equal, extending beyond the fruit, silky pubescent on the internerves; fruit 2 mm. long, oblong-elliptic, pale.

Open or wooded grassy hillsides, Nicaragua, Salvador, Panama, and Venezuela.

CANAL ZONE: Ancón, *Hitchcock 19891;* between Culebra and Pedro Miguel, *Hitchcock 7928* (TYPE); Balboa, *Hitchcock 8019.* PANAMÁ: Taboga Island, *Hitchcock 8077.*

52. PASPALUM L.

PASPALUM L. Syst. Nat. ed. 10. 2:855. 1759.

Spikelets plano-convex, solitary or in pairs, arranged in two rows on one side of a narrow wingless to broadly winged rachis, the back of the fruit turned toward the rachis; first glume wanting or present on some, occasionally on all of the spikelets; second glume and sterile lemma equal, covering the fruit, or the glume a little shorter, rarely wanting; fruit indurate, usually pale, sometimes dark brown, smooth and shining or minutely striate, the margins of the lemma inrolled, enclosing the palea.

Annuals or perennials with one to many racemes, these solitary, paired, or racemose at the summit of the main culm and branches.

a. Inflorescence feathery, composed of numerous, very slender, drooping racemes, crowded on a short axis ..... 39. P. SACCHAROIDES
aa. Inflorescence not feathery, the racemes, if hairy, not long, slender, and drooping.
b. Rachis winged, with broad membranaceous margins, or if narrowly winged, the spikelets conspicuously fringed with long hairs.
c. Plants terrestrial; spikelets conspicuously silky or fringed with long hairs.
d. Spikelets 2.5–3.2 mm. long; second glume wingless; sterile lemma inconspicuously fringed.
e. Racemes solitary or sometimes paired, the rachis 5–7 mm. wide; culms simple ..... 1. P. STELLATUM
ee. Racemes 2–7, sometimes solitary on the branches, never paired, the rachis 2–4 mm. wide; culms usually branching.
f. Blades 2–3.5 mm. wide, flat or becoming involute; racemes 1–6 cm. long, the rachis 3–4 mm. wide; culms slender, erect ..... 2. P. HETEROTRICHON
ff. Blades 6–15 mm. wide, flat; racemes 5–10 cm. long, the rachis 2–3 mm. wide; culms relatively coarse, decumbent at the somewhat woody base ..... 3. P. HUMBOLDTIANUM
dd. Spikelets 4.5–6 mm. long; second glume broadly winged; sterile lemma fringed with long hairs.
e. Rachis narrower than the spikelets; glume cordate at base; fruit ciliate ..... 4. P. PECTINATUM
ee. Rachis wider than the spikelets; glume not cordate at the base; fruit glabrous ..... 5. P. CONTRACTUM
cc. Plants aquatic; spikelets glabrous.
d. Second glume well developed; spikelets 1.4–2 mm. long, elliptic, acute, in two rows, numerous on each raceme ..... 6. P. REPENS
dd. Second glume wanting; spikelets 2.3–2.5 mm. long, oblong, obtuse, appearing as if in a single row, relatively few on each raceme ..... 7. P. CANDIDUM
bb. Rachis wingless, or if narrowly winged, the spikelets not conspicuously silky or fringed with long hairs.
c. Racemes 2, conjugate or nearly so at the summit of the culm, rarely a third one a short distance below.
d. Plants extensively stoloniferous.
e. Spikelets 1.4–2.2 mm. long, ovate, sparsely long-ciliate around the margins ..... 26. P. CONJUGATUM
ee. Spikelets 3–4.5 mm. long, glabrous. Sea-coast plants ..... 8. P. VAGINATUM
dd. Plants cespitose or rhizomatous, but not stoloniferous.
e. Plants perennial; spikelets 2 mm. long or more.
f. Spikelets 2–3.8 mm. long, ovate to obovate, or, if elliptic, pubescent.
g. Rhizomes stout, horizontal, forming a tough sod; spikelets glabrous.

h. Spikelets 2.5–3.8 mm. long, ovate to obovate, smooth and shining ..... 9. P. NOTATUM
hh. Spikelets 2–2.5 mm. long, oval, less shining than the preceding ..... 10. P. MINUS
gg. Rhizomes short; spikelets pubescent ..... 11. P. SUBCILIATUM
ff. Spikelets 4–4.5 mm. long, elliptic, glabrous, with a short tuft of hairs on either side at the base. Base of plant usually covered with old shredded sheaths ..... 12. P. LINEARE
ee. Plants annual; spikelets 1.1–1.5 mm. long.
f. Spikelets subhemispheric, solitary, beaded with globular hairs, rarely glabrous ..... 18. P. MULTICAULE
ff. Spikelets elliptic or obovate, paired, pubescent with capitate hairs ..... 19. P. CLAVULIFERUM
cc. Racemes 1–many, racemose or fascicled on the axis, not conjugate.
d. Second glume wanting. Pedicels bearing stiff hairs at least as long as the spikelet ..... 37. P. GARDNERIANUM
dd. Second glume well developed.
e. First glume present on at least one of a pair of spikelets (see also *P. fasciculatum*, a coarse aquatic).
f. Plants decumbent, creeping; spikelets not more than 2 mm. long.
g. First glume about equally developed on all spikelets ..... 14. P. DECUMBENS
gg. First glume wanting, or occasionally developed, especially on the secondary spikelet ..... 15. P. NUTANS
ff. Plants erect; spikelets 2.6–3 mm. long ..... 16. P. PILOSUM
ee. First glume wanting, or occasionally developed on some of the spikelets.
f. Racemes terminal and axillary, the axillary sometimes hidden in the sheaths.
g. Culms decumbent, rooting at the lower nodes; first glume occasionally developed ..... 15. P. NUTANS
gg. Culms erect; first glume always wanting ..... 13. P. PROPINQUUM
ff. Racemes terminal only on the main culm and branches.
g. Plants annual.
h. Spikelets with a broad firm notched margin ..... 38. P. FIMBRIATUM
hh. Spikelets without a broad notched margin.
i. Fruit pale; spikelets not more than 1.5 mm. long.
j. Spikelets 0.8 mm. long, oblong-elliptic, glabrous, with raised margins; rachis zigzag ..... 20. P. PARVIFLORUM
jj. Spikelets 1.1–1.6 mm. long, hemispherical or elliptic, sparsely to densely covered with globular or capitate hairs.
k. Blades 6–20 mm. wide; racemes 6–35, scattered on a long axis ..... 22. P. MICROSTACHYUM
kk. Blades not more than 2.5 mm. wide; racemes 1 or 2.
l. Spikelets subhemispheric, solitary, beaded with globular hairs, rarely glabrous ..... 18. P. MULTICAULE
ll. Spikelets elliptic or obovate, paired, pubescent with capitate hairs ..... 19. P. CLAVULIFERUM
ii. Fruit dark brown, smooth and shining.
j. Spikelets suborbicular, or if obovate, 2.2–3 mm. long.
k. Culms slender, mostly 20–40 cm. high, decumbent-spreading; racemes 1–4, the rachis 1–2 mm. wide; sheaths and blades usually rather conspicuously papillose-pilose ..... 34. P. CONVEXUM
kk. Culms mostly stout, commonly 40–60 cm. high; racemes commonly 4–11, the rachis 2–2.5 mm. wide; sheaths and blades glabrous or nearly so ..... 35. P. BOSCIANUM
jj. Spikelets obovate, 2 mm. long ..... 36. P. MELANOSPERMUM
gg. Plants perennial.
h. Culms creeping, rooting at the lower nodes. Spikelets solitary, not more than 1.8 mm. long.

i. Spikelets suborbicular.
j. Blades 1–6 cm. long; spikelets 1–1.2 mm. long. Plants stoloniferous ..... 23. P. ORBICULATUM
jj. Blades 5–13 cm. long; spikelets 1.7–1.8 mm. long. Subaquatic ..... 25. P. HITCHCOCKII
ii. Spikelets ovate to more or less elliptic, acutish ..... 24. P. JIMENEZII
hh. Culms not creeping, if rooting at the lower nodes the spikelets in pairs or more than 4 mm. long.
i. Plants stoloniferous, coarse, succulent; spikelets 4–4.5 mm. long, solitary. Racemes usually numerous, arranged in a dense flabellate inflorescence ..... 27. P. FASCICULATUM
ii. Plants not stoloniferous, erect; spikelets not more than 3.9 mm. long, usually much less.
j. Fruit dark brown, smooth and shining.
k. Sterile lemma wrinkled just within the margins. 32. P. PLICATULUM
kk. Sterile lemma flat ..... 33. P. CENTRALE
jj. Fruit pale to stramineous, or if brown not shining, striate-roughened.
k. Spikelets 1.3–1.6 mm. long; culms usually slender.
l. Racemes 7–60, the lower ones 4–12 cm. long; culms 0.3–2 m. high; spikelets subhemispherical, 1.3–1.5 mm. long, pubescent ..... 17. P. PANICULATUM
ll. Racemes 2–4, 2.2–4 cm. long; culms 20–27 cm. high; spikelets narrowly obovate or elliptic, 1.6 mm. long; glabrous ..... 21. P. STANDLEYI
kk. Spikelets 1.9 mm. long or more; culms coarse and robust, mostly 1–2 m. high.
l. Culms freely branching at maturity. Spikelets elliptic, glandular-pubescent, 2–2.5 mm. long ..... 31. P. CORYPHAEUM
ll. Culms simple or with a few simple branches.
m. Spikelets obovate or suborbicular, 1.9–3 mm. long.
n. Racemes 50–100, crowded; spikelets 1.9–2.2 mm. long, glabrous; fruit pale 30. P. DENSUM
nn. Racemes less than 30, commonly 10–16; spikelets 2.2–3 mm. long; fruit dark brown ..... 28. P. VIRGATUM
mm. Spikelets elliptic, acute, 3.5–3.9 mm. long. Second glume ciliate on the margins toward the summit, otherwise glabrous ..... 29. P. ACUTUM

1. PASPALUM STELLATUM Humb. & Bonpl. in Flügge, Monogr. Pasp. 62. 1810.

Paspalus stellatus var. *monostachyus* Nees, Agrost. Bras. 78. 1829.
Paspalus stellatus var. *distachyus* Nees, Agrost. Bras. 78. 1829.
Paspalum cujabense Trin. Gram. Icon. 3: *pl. 284.* 1831.
Paspalum wagenerianum Schlecht. Linnaea 26:133. 1853.
Paspalum splendens var. *sphacelatum* Hack. Oesterr. Bot. Zeitschr. 51:239. 1901.
Paspalum stellatum forma *hirsuta* Hack. in Stuck. Anal. Mus. Nac. Buenos Aires 21:28. 1911.

Perennial; culms 40–80 cm. high, erect, simple, glabrous or appressed-pubescent toward the summit; sheaths mostly longer than the internodes, the lower papillose-hirsute, the upper nearly glabrous; ligule membranaceous, ciliate, about 0.5 mm. long; blades 8–25 cm. long, 2–3 mm. wide, the uppermost reduced, involute-setaceous or flat toward the base, papillose-pilose or the lower surface glabrous; racemes 2.5–10 cm. long, solitary or paired, ascending, the rachis 5–7 mm. wide, golden-brown or purplish, the short peduncle pubescent; spikelets about

3 mm. long, solitary, closely imbricate on short radiately pilose pedicels; glume and sterile lemma subequal, the margins fringed with white hairs, those on the upper half much exceeding the spikelet; fruit 2 mm. long, minutely stipitate, smooth and shining.

Savannas and open rocky slopes, Mexico (Oaxaca) and Hispaniola to Argentina.

COCLÉ: between Paso del Arado and Olá, *Pittier 5020;* Picacho de Olá, *Pittier 5064;* El Valle de Antón, *Allen 2823.* VERAGUAS: Santiago, *Allen 1017.*

2. PASPALUM HETEROTRICHON Trin. Gram. Icon. 3: *pl. 285.* 1831.

Paspalum (Ceresia) gracile Schlecht. Linnaea 10:134. 1854. Not *P. gracile* Rudge, 1805.
Paspalum heterotrichum var. *paucispicatum* Hack. Notizbl. Bot. Gart. Berlin 1:328. 1897.

Fig. 18. *Paspalum heterotrichon*

Perennial; culms tufted, 50–90 cm. high, slender, wiry, finally branching from the middle and upper nodes, the nodes bearded with appressed hairs; sheaths longer than the internodes, the margins ciliate, pubescent on the collar, with a tuft of usually long hairs at the throat; blades 3–15 cm. long, 2–3.5 mm. wide, involute, acuminate or attenuate to a rather fine point, puberulent on the upper surface, the lower surface glabrous or nearly so; racemes 1–7, 1–6 cm. long, ascending-falcate on very short bearded peduncles, the rachis 3–4 mm. wide, golden; spikelets 2.5 mm. long, solitary, imbricate, acute, somewhat obscured by the long white hairs on the margins and at the base of the glume, the sterile lemma narrower, short-ciliate toward the apex; fruit 1.7 mm. long, scarcely indurate, minutely puberulent at the apex.

Dry woods and grassy hillsides, Haiti; Panama to Peru and Brazil.

CHIRIQUÍ: El Boquete, *Hitchcock 8235, 8297;* Volcán de Chiriquí, *Killip 4555.*

3. PASPALUM HUMBOLDTIANUM Flügge, Monogr. Pasp. 67. 1810.

Paspalum distichophyllum H.B.K. Nov. Gen. & Sp. 1:86. 1815.
Paspalum ciliatum H.B.K. Nov. Gen. & Sp. 1:87. *pl. 24.* 1815. Not *P. ciliatum* Lam., 1791.
Paspalum blepharophorum Roem. & Schult. Syst. Veg. 2:292. 1817.
Panicum obtectum Presl, Rel. Haenk. 1:301. 1830.
Tricholaena obtecta Fourn. Mex. Pl. 2:35. 1886.

Panicum humboldtianum Kuntze, Rev. Gen. Pl. 3³:361. 1898.

Perennial; culms 40–105 cm. high, erect from a decumbent almost woody base, commonly branching, the nodes bearded with ascending hairs; sheaths mostly longer than the internodes, sometimes crowded, papillose-hispid at least toward the summit; ligule 1–2 mm. long, dark brown; blades 8–18 cm. long, 6–15 mm. wide, acuminate, firm, stiffly spreading, the upper surface glabrous or nearly so, the lower surface usually pubescent, also with a few scattered long hairs, the margins prominently papillose-hispid at least toward the base; racemes mostly 2–5, rarely more, 5–10 cm. long, ascending or drooping, the rachis 2–3 mm. wide with a tuft of long hairs at the base; spikelets 3.2 mm. long, solitary or paired, elliptic, acute, the glume and sterile lemma equal, fringed with long spreading glistening white hairs; fruit about 2.8 mm. long, smooth and shining.

Open or brushy slopes, Mexico to Argentina.

CHIRIQUÍ: El Boquete, *Hitchcock 8186; Killip 4522.*

4. PASPALUM PECTINATUM Nees in Trin. Gram. Icon. 1: *pl. 117.* 1828.
Anastrophus pectinatus Schlecht. ex Jacks. Ind. Kew. 1:118. 1893.

Perennial; culms in coarse tufts 30–100 cm. high, simple, erect, glabrous; lower sheaths crowded, firm, reddish, harshly villous toward the summit, smooth and shining toward the base; ligule firm, about 1 mm. long; blades 12–60 cm. long, 3–5 mm. wide, the uppermost reduced, erect or nearly so, densely harshly villous; racemes usually 2, sometimes 1 or 3, erect or ascending, 4–8 cm. long, the rachis 1.8–2.3 mm. wide, the margins irregular, densely villous with rather coarse hairs at the base; spikelets 4.5–6 mm. long, solitary, imbricate; glume and sterile lemma flat, cordate-lanceolate, the sterile lemma narrower and shorter than the glume, sparsely tuberculate-hispid on the back, the thickened margins tuberculate-ciliate with stiff spreading hairs 2–3 mm. long; fruit 4.2–4.5 mm. long, lanceolate, obtuse, the lemma and palea rather thin, the lemma shortly ciliate toward the summit.

Savannas and open rocky slopes, Honduras to southern Brazil.

CHIRIQUÍ: Cerro Vaca, *Pittier 4351.* PANAMÁ: Taboga Island, *Pittier 3584; Hitchcock 8096.*

5. PASPALUM CONTRACTUM Pilger, Bot. Jahrb. (Engler) 25:709. 1898.
Paspalum echinotrichum Mez, Bot. Jahrb. (Engler) 56: Beibl. 125:9. 1921.

Perennial; culms 50–90 cm. high, tufted, erect, the lower and middle nodes with a dense ring of erect white hairs; leaves mostly crowded toward the base, the lower sheaths densely papillose-pilose toward the summit, glabrate and becoming more or less fibrous toward the base, the upper ones glabrous, nearly bladeless; ligule about 1 mm. long, firm, dark brown; blades 10–25 cm. long, 2–4 mm. wide, erect or nearly so, densely long-pilose on both surfaces, the margins sparsely papillose-ciliate; racemes 2 or 3, suberect, 3.5–7 cm. long, the rachis 4.5–5 mm. wide, densely pilose at the base, the center greenish, the wings golden-brown; spikelets 5–5.5 mm. long, solitary, closely imbricate, lanceolate, acuminate, densely

bearded at the base; sterile lemma a little shorter and narrower than the glume, the thickened margins papillose-ciliate, the hairs becoming sparse toward the summit; fruit 3.8 mm. long, pale, glabrous, minutely stipitate.

Open slopes, Panama to Brazil.

COCLÉ: Picacho de Olá, *Pittier 5063*.

6. PASPALUM REPENS Bergius, Act. Helv. Phys. Math. 7:129. *pl. 7.* 1762.

Paspalum gracile Rudge, Pl. Guian. 20. *pl. 26.* 1805.
Paspalum mucronatum Muhl. Cat. Pl. 8. 1813.
Ceresia fluitans Ell. Bot. S. C. & Ga. 1:109. *pl. 6. f. 4.* 1816.
Paspalum mucronatum Muhl. Descr. Gram. 96. 1817.
Paspalum natans LeConte, Jour. de Phys. Chym. 91:285. 1820.
Paspalum fluitans Kunth, Rév. Gram. 1:24. 1829.
Paspalum pyramidale Nees, Agrost. Bras. 77. 1829.
Paspalum frankii Steud. Syn. Pl. Glum. 1:19. 1854.
Paspalum bistipulatum Hochst. ex Steud. Syn. Pl. Glum. 1:29. 1854.
Cymatochloa fluitans Schlecht. Bot. Zeit. 12:822. 1854.
Cymatochloa repens Schlecht. Bot. Zeit. 12:822. 1854.

Aquatic perennial; culms submerged, spongy, with long roots at the nodes and numerous floating branches, the nodes glabrous or sometimes hispid; sheaths longer than the internodes, inflated except the uppermost on the branches, soft, papery, glabrous or sparsely papillose-hispid, auriculate; ligule 1–2 mm. long, brown; blades 10–27 cm. long, 1.2–2.5 cm. wide, thin, flat, scabrous; panicles 10–20 cm. long, shortly exserted; racemes numerous, mostly 3–5 cm. long, spreading or even reflexed, the rachis about 1.5 mm. wide, scabrous on the margins, acuminate, extending beyond the spikelets, naked for a short distance at the base; spikelets 1.4–2 mm. long, solitary, whitish, pubescent or glabrous, the glumes and sterile lemma pointed beyond the fruit; fruit 1.4–1.7 mm. long, smooth and shining.

Floating in open water on margins of rivers, lakes, and canals, sometimes creeping in wet places, South Carolina to Indiana and Kansas, south to Paraguay.

CANAL ZONE: Chagres River, *D. H. Popenoe 36;* Gatún, *Hitchcock 8031, 9179;* Frijoles, *Standley 31464;* Gamboa, *Standley 28482;* Juan Mina, *Piper 5205; Bartlett & Lasser 16752; 16885;* Pedro Miguel River, *D. P. Curry;* Mindozo River, *Killip 4231.* PANAMÁ: Matías Hernández, *Pittier 6808;* La Jagua, *Bartlett & Lasser 17001, 17010.*

7. PASPALUM CANDIDUM (Humb. & Bonpl.) Kunth, Mém. Mus. Hist. Nat. 2:68. 1815.

Reimaria candida Humb. & Bonpl. ex Flügge, Monogr. Pasp. 214. 1810.

Annuals; culms 15 cm. to more than 1 m. or more long, erect or ascending from a decumbent base, straggling or even clambering, rooting at the lower nodes, freely branching, flattened, smooth and shining or rarely retrorsely scabrous below the nodes; sheaths usually shorter than the internodes, thin and rather loose, the margins ciliate toward the summit; ligule about 1.5 mm. long, erose; blades 5–10 cm. long, 6–20 cm. wide, thin, flat, pilose or papillose-pilose on both surfaces or nearly glabrous, the margins scabrous; panicles 5–12 cm. long, scarcely exserted; racemes 8–20, ascending or spreading, 2–4 cm. long, falling entire, the rachis

2–2.5 mm. wide, scabrous, densely pubescent at the base, extending beyond the spikelets; spikelets 2.3–2.5 mm. long, solitary, rather distant, oblong, glabrous, the glume wanting; fruit as long as the sterile lemma, white, smooth and shining.

Moist shady banks and open woods, Mexico (Veracruz) to Chile.

CHIRIQUÍ: El Boquete, *Killip 4510.*

8. PASPALUM VAGINATUM Swartz, Prodr. Veg. Ind. Occ. 21. 1788.
Paspalum littorale R. Br. Prodr. Fl. Nov. Holl. 188. 1810.
Digitaria foliosa Lag. Gen. & Sp. Nov. 4. 1816.
Paspalum tristachyum LeConte, Jour. de Phys. Chym. 91:285. 1820.
Digitaria tristachya Schult. Mant. 2:261. 1824.
Paspalum foliosum Kunth, Rév. Gram. 1:25. 1829.
Paspalum kleineanum Presl, Rel. Haenk. 1:209. 1830.
Paspalum inflatum A. Rich. in Sagra, Hist. Cuba 11:298. 1850.
Paspalum vaginatum var. *longipes* Lange, Naturhist. For. Kjöbenhavn Vid. Medd. 1854:44. 1854.
Paspalum vaginatum Gren. & Godr. Fl. Franc. 3:462. 1856. Not *P. vaginatum* Nees, 1829.
Paspalum distichum var. *tristachum* Wood, Class-book. ed. 3. 783. 1861.
Paspalum distichum var. *vaginatum* Swartz ex Griseb. Fl. Brit. W. Ind. 541. 1864.
Paspalum vaginatum var. *nanum* Doell in Mart. Fl. Bras. 2^2:75. 1877.
Paspalum reimarioides Chapm. Fl. South. U. S. 665. 1883.
Paspalum vaginatum var. *reimarioides* Chapm. Fl. South. U. S. ed. 3. 577. 1897.
Paspalum distichum var. *nanum* Stapf in Thiselt.-Dyer, Fl. Cap. 7:371. 1898.
Sanguinaria vaginata Bubani, Fl. Pyr. 4:258. 1901.

Rhizomatous stoloniferous perennial; culms 10–60 cm. high, erect or ascending, strongly compressed, simple or branching, glabrous; stolons as much as 1 m. long, slender to rather stout with short internodes, the sheaths bladeless or with short reflexed blades; sheaths of the culms longer than the internodes, loose, keeled, pilose in the throat; ligule membranaceous, about 0.5 mm. long; blades 2.5–15 cm. long, commonly about 10 cm., 3–8 mm. wide, narrower than the mouth of the sheath, gradually narrowed to a more or less involute tip, conspicuously distichous; racemes 1.5–7.5 cm. long, usually 2, sometimes 3–5, conjugate or approximate, erect to spreading or reflexed, somewhat falcate; spikelets 3–4.5 mm. long, solitary, imbricate, acute, glabrous, the first glume rarely developed; second glume and sterile lemma equal, thin, the lemma transversely undulate; fruit 2.5–3 mm. long, obovate, acute.

Sea-coasts, North Carolina and Baja California to Argentina and Chile; also in the tropics and subtropics of the Eastern Hemisphere.

COLÓN: Río Indio de Fató, *Pittier 4261.* CANAL ZONE: Cristóbal, *Pittier 4232; Hitchcock 8034;* Toro Point, *Hitchcock 8042;* Balboa, *Hitchcock 7996; Standley 30881.* PANAMÁ: Panamá, *Hitchcock 8403;* Punta Paitilla, *Standley 30799.*

9. PASPALUM NOTATUM Flügge, Monogr. Pasp. 106. 1810.
Paspalum taphrophyllum Steud. Syn. Pl. Glum. 1:19. 1854.
Paspalum distachyon Willd. ex Doell in Mart. Fl. Bras. 2^2:73. 1877. Not *P. distachyon* Poit., 1834.
Paspalum notatum var. *latiflorum* Doell in Mart. Fl. Bras. 2^2:73. 1877.
Paspalum saltense Arech. Anal. Mus. Nac. Montevideo 1:53. 1894.

Rhizomatous perennial forming dense sods; culms 15–50 cm. high, flattened,

glabrous; leaves crowded toward the base, the lower sheaths short, overlapping, those of the culm few, elongate; sheaths keeled, compressed, glabrous or sometimes pubescent, the margins often ciliate toward the summit; ligule very short, membranaceous; blades 2–30 cm. long, 3–10 mm. wide, glabrous, the margins ciliate at least toward the base; racemes 2 or rarely 3, 2.5–12 cm. long, subconjugate, ascending, more or less arcuate, the rachis about 1 mm. wide; spikelets 2.5–3.8 mm. long, solitary, ovate or obovate, the glume and sterile lemma equal, firm, smooth and shining; fruit 2.5–3.5 mm. long, oval.

Open ground, Mexico and the West Indies to Argentina.

CHIRIQUÍ: David, *Hitchcock 8367;* Boquete, *Woodson & Schery 725.* COCLÉ: between Las Margaritas and El Valle, *Woodson, Allen & Seibert 1265.* CANAL ZONE: Balboa, *Hitchcock 7998, 8009.* PANAMÁ: Chepo, *Pittier 4453;* Chorrera, *Hitchcock 8136.*

10. PASPALUM MINUS Fourn. Mex. Pl. 2:6. 1886.

Perennial, similar in aspect to *P. notatum;* culms 10–40 cm. high, more slender than *P. notatum;* sheaths keeled, glabrous, the margins papillose-ciliate at least toward the summit; blades 3–15 cm. long, 2–6 mm. wide, abruptly acute, the margins sparsely papillose-ciliate; racemes 2, conjugate, rarely 3, 3–7 cm. long, slender, narrowly ascending to spreading; spikelets 2–2.5 mm. long, ovate, less shining than those of *P. notatum.*

Open grassy slopes, savannas, and dry fields, Central Mexico and the West Indies to Paraguay and Bolivia.

CHIRIQUÍ: Cerro Vaca, *Pittier 5345;* Bajo Boquete, *Killip 4582;* El Boquete, *Hitchcock 8234.* CANAL ZONE: Gatún, *Hitchcock 7973, 7978;* Ancón Hill, *Standley 26355; Killip 4027.* PANAMÁ: Chorrera, *Hitchcock 8123;* Chepo, *Pittier 4624.*

11. PASPALUM SUBCILIATUM Chase, Jour. Washington Acad. Sci. 17:144. *f. 1.* 1927.

Perennial; culms in dense tufts, 15–45 cm. high, erect from short knotty rhizomes, the bases somewhat swollen; sheaths glabrous or the margins ciliate toward the summit, the lower ones short and crowded, the lowermost scale-like, the uppermost elongate, bladeless; ligule 0.5 mm. long, ciliate; blades 5–20 cm. long, 2–5 mm. wide, attenuate, more or less involute, long-pilose on the upper surface near the base; racemes 2, conjugate, sometimes with a third a short distance below, 3–6.5 cm. long, narrowly ascending or spreading, the rachis narrow, flexuous, densely pilose at the usually naked base; spikelets 2.2–2.4 mm. long, solitary, elliptic, subacute; glume and sterile lemma equal, pointed beyond the fruit, the glume pubescent or pilose, the hairs longer on the margins, the lemma glabrous or with a few hairs on the margins; fruit about 2 mm. long, yellowish, minutely striate.

Open savannas, Panama and Brazil.

CHIRIQUÍ: Dolega, *Hitchcock 8339.* CANAL ZONE: Balboa, *Hitchcock 8017* (TYPE). PANAMÁ: Chepo, *Pittier 4500.*

12. PASPALUM LINEARE Trin. Gram. Pan. 99. 1826.

Paspalum angustifolium Nees, Agrost. Bras. 64. 1829.

Paspalum neesii Kunth, Rév. Gram. 1:25. 1829.
Panicum furcellatum S. Moore, Trans. Linn. Soc. London Bot. II. 4:505. *pl. 34. f. 14-22.* 1895.

Perennial; culms densely tufted, erect, 40–80 cm. high, the nodes densely pilose with ascending hairs; lower sheaths crowded, becoming fibrous with age, keeled, sparsely to rather densely ascending-pilose toward the summit, the upper ones elongate, nearly bladeless, glabrate; ligule membranaceous, very short; blades conduplicate, 5–50 cm. long, 0.5–1.5 mm. wide as folded, erect or nearly so, densely pilose on the upper surface at the base; racemes 2 or rarely 3, approximate, 3–5.5 cm. long, the rachis narrowly winged, flexuous, densely pilose at the base; spikelets 4–4.5 mm. long, solitary, scarcely imbricate, with a short tuft of hairs on either side at the base; glume and sterile lemma equal, firm, pointed beyond the fruit; fruit 3.8–4.3 mm. long, pale, blunt, minutely striate, roughened.

Savannas, Costa Rica and Cuba to Argentina.

CHIRIQUÍ: Boquete District, *Davidson 833*.

13. PASPALUM PROPINQUUM Nash, Bull. N. Y. Bot. Gard. 1:291. 1899.

Perennial; culms densely tufted, erect from short knotty rhizomes, 15–75 cm. high, with terminal and axillary inflorescences; sheaths glabrous or pilose, the margins ciliate, the lower ones rather short, overlapping, the upper one distant, elongate; blades mostly 5–15 cm. long, rarely more than 25 cm., 4–10 mm. wide, rounded at the base, glabrous on both surfaces, the margins sparsely papillose-ciliate; racemes 1–3, erect to arcuate-spreading, 4–8 cm. long; spikelets paired, 1.7–1.9 mm. long, elliptic-obovate, slightly pointed, glabrous or sparsely pubescent with capitate hairs.

Open sandy ground, Florida, Mexico (Veracruz) and the West Indies to Panama.

PANAMÁ: Panamá, *Hitchcock 8099;* Point Chamé, *Hitchcock 8165.*

14. PASPALUM DECUMBENS Swartz, Prodr. Veg. Ind. Occ. 22. 1788.

Paspalum pedunculatum Poir. in Lam. Encycl. Suppl. 4:315. 1816.
Panicum decumbens Roem. & Schult. Syst. Veg. 2:429. 1817.
Paspalum vaginiflorum Steud. Syn. Pl. Glum. 1:19. 1854.
Dimorphostachys pedunculata Fourn. Mex. Pl. 2:15. 1886.

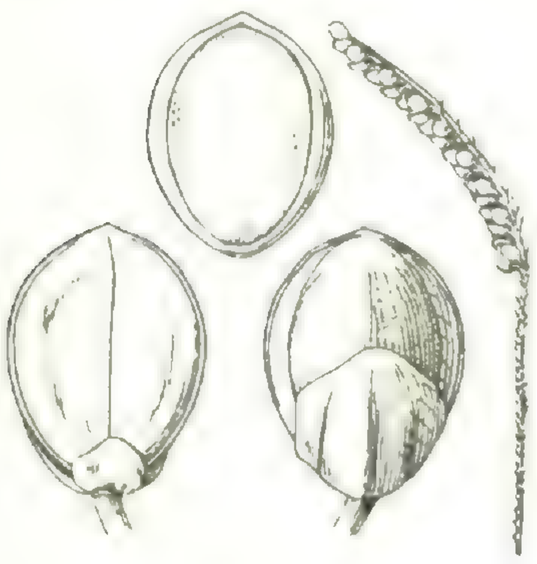

Fig 19
Paspalum decumbens

Perennial, sometimes appearing almost like an annual; culms 10–70 cm. long, freely branching, erect or usually decumbent-spreading, the ends ascending, often rooting at the lower, more or less pubescent or pilose nodes; sheaths about as long as or a little shorter than the internodes, compressed, keeled, papillose-pilose to nearly glabrous, the margins densely ciliate; ligule membranaceous, about 0.5 mm. long; blades 2–15 cm. long, usually 5–10 cm., 6–12 mm. wide, rounded at the base, acuminate, softly pubescent on both surfaces or glabrous with a few scattered stiff hairs, the margins papillose-

ciliate; peduncles 2–8 from the upper sheaths, slender, usually elongate; racemes solitary, 1–3.5 cm. long, arcuate; rachis very narrow, pubescent at the base; spikelets paired, 1.7 mm. long, obovate, glabrous, the first glume developed; second glume obtuse, about half as long as the spikelet; fruit as long as the sterile lemma, pale, minutely striate.

Open or brushy banks, woods, and thickets, often a weed in waste ground, Guatemala and the West Indies to Brazil and Bolivia.

BOCAS DEL TORO: Laguna de Chiriquí, *Hart 180.* CHIRIQUÍ: David, *Hitchcock 8361;* San Felix, *Pittier 5185, 5752.* COLÓN: Permé, *G. Proctor Cooper III 270;* Cativa1, *Standley 30274.* CANAL ZONE: Barro Colorado Island, *Kenoyer 128;* Obispo, *Standley 31662;* Culebra, *Hitchcock 7939, 8115;* between Pedro Miguel and Corozal, *Hitchcock 7990;* Balboa, *Standley 29299.* PANAMÁ: Chorrera, *Hitchcock 8141;* Taboga Island, *Hitchcock 8088.*

15. PASPALUM NUTANS Lam. Tabl. Encycl. 1:175. 1791.

Paspalum curvistachyum Raddi, Agrost. Bras. 26. 1823.
Paspalum protensum Trin. Gram. Pan. 108. 1826.
Paspalum singulare Link, Hort. Berol. 1:48. 1827.
Paspalum heteropodium Steud. Syn. Pl. Glum. 1:19. 1854.
Paspalum boivini Steud. Syn. Pl. Glum. 1:416. 1855.
Paspalum lloydii Nash, N. Amer. Fl. 17:178. 1912.

Perennial; culms 25–90 cm. long, erect from a decumbent base, spreading or creeping, freely branching, rooting at the lower nodes; sheaths shorter than the internodes or the lower ones overlapping, compressed, keeled, glabrous, the margins usually ciliate; ligule membranaceous, 1–1.5 mm. long; blades 4–16 cm. long, 5–15 mm. wide, lanceolate, acuminate, rounded at the base, glabrous or pubescent with a few coarse hairs on the upper surface at the base, the margins scabrous and often more or less papillose-ciliate; peduncles 1–4 from the terminal sheaths, finally elongate; racemes 1–5, 2–6 cm. long, arcuate, the rachis narrow, glabrous, slightly flexuous, with a few long hairs at the base; spikelets paired, 1.8–2 mm. long, obovate, glabrous, the first glume usually obsolete, the second glume obtuse, about three-fourths as long as the spikelet; fruit as long as the sterile lemma, pale, striate.

Shady banks, along streams, and moist thickets, Honduras and the Leeward Islands to Brazil; also on the island of Mauritius.

CHIRIQUÍ: El Boquete, *Hitchcock 8230;* San Felix, *Pittier 5753.* CANAL ZONE: Toro Point, *Hitchcock 8047;* Balboa, *Standley 25445, 26049;* Sabana de Marcelito, *Pittier 2381.* PANAMÁ: Río Chagres, *Dodge & Allen 17352, 17412;* Juan Díaz, *Killip 4125;* Chepo, *Pittier 4719.*

16. PASPALUM PILOSUM Lam. Tabl. Encycl. 1:175. 1791.

Panicum monostachyum H.B.K. Nov. Gen. & Sp. 1:96. 1815.
Panicum monobotrys Trin. ex Steud. Syn. Pl. Glum. 1:55. 1854.
Panicum monostachyum var. α. *robustius* Doell in Mart. Fl. Bras. 2^2:182. 1877.
Panicum monostachyum var. *minus* Kunth ex Doell in Mart. Fl. Bras. 2^2:182. 1877.
Dimorphostachys monostachya Fourn. Mex. Pl. 2:14. 1886.
Dimorphostachys pilosa Fourn. Mex. Pl. 2:14. 1886.

Perennial; culms 40–115 cm. high, erect or ascending, simple or sparingly

branched from the middle nodes, the nodes densely short-pubescent or nearly glabrous; sheaths shorter than the internodes, keeled, from glabrous to papillose-pilose, hairy on the collar, the margins rather densely ciliate; ligule membranaceous, 1–1.5 mm. long; blades 10-40 cm. long, 3–10 mm. wide, stiff, somewhat spreading, densely pilose on both surfaces, the hairs rather stiff, the margins scabrous; peduncles 1–4 from the upper and middle sheaths, elongate or almost included; racemes solitary, 6–17 cm. long, arcuate, the rachis narrowly winged, the margins scabrous, more or less ciliate; spikelets paired, crowded, 2.6–3 mm. long, elliptic, glabrous; first glume small or as much as half as long as the spikelet, rarely obsolete; second glume and sterile lemma firm, subequal, or the second glume a little shorter, exposing the fruit, the lemma enclosing a palea and sometimes a staminate flower; fruit about 2.5 mm. long, striate.

Savannas, thickets, and grassy slopes, usually in moist soil, Costa Rica to Bolivia and southern Brazil.

CHIRIQUÍ: David, *Hitchcock 8365;* Cerro Vaca, *Pittier 5325, 5364;* El Boquete, *Hitchcock 8192, 8298;* Bajo Boquete, *Killip 4558.* CANAL ZONE: between Pedro Miguel and Corozal, *Hitchcock 7988;* Ancón, *Killip 4011; Standley 25205.* PANAMÁ: Chorrera, *Hitchcock 8130.*

17. PASPALUM PANICULATUM L. Syst. Nat. ed. 10. 2:855. 1759.

Paspalum hemisphericum Poir. Encycl. 5:31. 1804.
Paspalum strictum Pers. Syn. Pl. 1:86. 1805.
Paspalum compressicaule Raddi, Agrost. Bras. 29. 1823.
Paspalum supinum Rupr. ex Galeotti, Bull. Acad. Sci. Brux. 9:237. 1842. Not *P. supinum* Bosc.
Paspalum multispica Steud. Syn. Pl. Glum. 1:18. 1854.
Paspalum affine Bello, Anal. Soc. Españ. Hist. Nat. 12:125. 1883. Not *P. affine* Steud., 1854.
Paspalum paniculatum β. rigidum Schlecht. ex Fourn. Mex. Pl. 2:9. 1886.
Paspalum cordovense Fourn. Mex. Pl. 2:9. 1886.
Paspalum galmarra F. M. Bailey, Dept. Agr. Brisbane Bot. Bull. 9:12. 1894.
Paspalum paniculatum var. *minor* S. Moore, Trans. Linn. Soc. Bot. II. 4:503. 1895.
Panicum paniculatum Kuntze, Rév. Gen. Pl. 3^3:363. 1898.
Paspalum paniculatum minor Scribn. Field. Mus. Bot. 2:24. 1900.

Fig. 20. *Paspalum paniculatum*

Perennial; culms densely tufted, 0.3 to more than 2 m. high, coarse, leafy, erect or ascending, sometimes decumbent at the base and rooting at the lower nodes, finally branching, the nodes glabrous to conspicuously bearded with stiff ascending hairs; sheaths mostly longer than the internodes, keeled, papillose-hispid, sometimes only on the collar and along the margins, colored orange-brown on the inner

surface; ligule 1–3 mm. long; blades 9–50 cm. long, 6–25 mm. wide, usually rounded at the base, densely hispid on both surfaces to nearly glabrous, with a tuft of long hairs on each side at the base, the margins scabrous, more or less hispid-ciliate; inflorescence 5–30 cm. long, composed of 7–60 approximate, solitary or somewhat fascicled racemes, the lower ones 4–12 cm. long, ascending or arcuate-spreading; spikelets paired, 1.3–1.5 mm. long, densely crowded, the glume and sterile lemma equal, barely covering the fruit, softly pubescent, the sterile lemma woolly pubescent only on the margins; fruit about as large as the spikelet, smooth and shining.

Moist open ground, brushy slopes, forests, fields, and waste places, Mexico and the West Indies to Argentina; also in west Africa, the Society Islands, and Queensland, Australia.

BOCAS DEL TORO: Almirante, *Cooper 124;* Laguna de Chiriquí, *Hart 65; von Wedel 1120;* Water Valley, *von Wedel 1761;* Bocas del Toro, *Carleton 182.* CHIRIQUÍ: David, *Hitchcock 8349;* El Boquete, *Hitchcock 8272; Pittier 3041.* COLÓN: Permé, *Cooper III 223.* CANAL ZONE: Frijoles, *Piper 5201;* Barro Colorado Island, *Standley 40953;* Darién Station, *Standley 31508, 31529;* Culebra, *Hitchcock 7907; Standley 25997;* Summit, *Standley 25813, 26966, 27314, 27328;* Ancón, *Killip 4112; Pittier 6767;* Balboa, *Macbride & Featherstone 43; Killip 4329.* PANAMÁ: Corozal Road, *Standley 26820;* Taboga Island, *Hitchcock 8071; Standley 27953.*

18. PASPALUM MULTICAULE Poir. in Lam. Encycl. Suppl. 4:309. 1816.

Paspalum papillosum Spreng. Nov. Prov. Hal. 47. 1819.

Annual; culms slender, densely tufted, freely branching from the lower nodes, ascending or spreading, mostly 10–30 cm. high, sometimes depauperate or rarely as much as 60 cm. tall; sheaths usually longer than the internodes, keeled, glabrous or more or less pilose, the margins often ciliate, especially toward the summit; blades 2–15 cm. long, 1.5–2.5 mm. wide, from nearly glabrous to densely short-pubescent, usually papillose-pilose as well; racemes 2, rarely 1 or 3, conjugate, divergent, 1.5–6 cm. long; spikelets 1.2–1.5 mm. long, subhemispheric, solitary, from glabrous to rather densely beaded with subglobular hairs; second glume and sterile lemma equal, covering the fruit, or the glume rarely reduced or wanting; fruit about the size of the spikelet, minutely striate.

Moist places in savannas, roadsides, and open ground, southern Mexico and Trinidad to Brazil and Bolivia.

CHIRIQUÍ: San Felix, *Pittier 5149.* COCLÉ: Aguadulce, *Pittier 4866, 4871.* CANAL ZONE: between Panamá and Corozal, *Hitchcock 9188, 9197½.* PANAMÁ: Chepo, *Pittier 4515, 4622;* between Panamá and Chepo, *Dodge, Hunter, Steyermark & Allen 16692.*

19. PASPALUM CLAVULIFERUM Wright, Anal. Acad. Cienc. Habana 8:203. 1871; Fl. Cub. 195. 1873.

Paspalum falcula Doell in Mart. Fl. Bras. 2^2:60. 1877.
Paspalum pittieri Hack. ex Beal, Grasses N. Amer. 2:88. 1896.

Annual; culms 5–45 cm. high, slender, tufted, erect to spreading, branching at the lower nodes; sheaths mostly overlapping, or shorter than the internodes in taller plants, papillose-hispid, sometimes with only a few hairs near the margins

toward the summit; ligule 0.5–1 mm. long; blades 3–16 cm. long, 1.5–4 mm. wide, ascending, sparsely to rather densely papillose-hispid, especially along the midnerve and on the margins; racemes solitary or paired, 1–5.5 cm. long, arcuate, long-exserted, the rachis slender, straight or somewhat flexuous; spikelets 1.1–1.5 mm. long, paired, elliptic or obovate, usually sparsely to densely pubescent with delicate capitate hairs, rarely glabrous, the second glume and sterile lemma equal or the glume a little shorter; fruit a little smaller than the spikelet, elliptic rather than obovate, striate.

Moist places in savannas, open or brushy slopes, and waste places, southern Mexico, and the West Indies to Colombia and Brazil.

CANAL ZONE: Madden Dam, *Bartlett & Lasser 16798*. PANAMÁ: Chepo, *Pittier 4525*.

20. PASPALUM PARVIFLORUM Rohdé ex Flügge, Monogr. Pasp. 98. 1810.

Paspalum parviflorum var. *humile* Nees ex Doell in Mart. Fl. Bras. 2^2:45. 1877.

Annual; culms slender, densely tufted, 4–17 cm. high, ascending or spreading, branching from the lower and middle nodes; sheaths mostly longer than the internodes, sparsely to rather densely papillose-pilose; ligule about 0.2 mm. long; blades 1.5–6.5 cm. long, 1–2 mm. wide, flat or loosely folded, flexuous, subattenuate, mostly conspicuously papillose-pilose with long fine hairs; racemes 1–4, stiffly spreading or reflexed, 6–26 cm. long, the rachis strongly zigzag, angular, scabrous on the angles, naked for a short space at the base; spikelets about 0.8 mm. long, solitary, oblong-elliptic, the second glume and sterile lemma thin with raised, somewhat thickened margins; fruit about as large as the spikelet, smooth and shining.

Dry savannas, Panama and Puerto Rico to Brazil.

PANAMÁ: Orange River, *Killip 4260*.

21. PASPALUM STANDLEYI Chase, Jour. Washington Acad. Sci. 17:146. 1927.

Perennial; culms 20–27 cm. high, slender, tufted, spreading, sometimes rooting at the lower nodes, glabrous or sparsely pilose below the nodes, these bearded with ascending hairs; sheaths overlapping, keeled, pilose or papillose-pilose, especially on the collar and along the margins; ligule about 0.2 mm. long; blades 3–6 cm. long, 3–6 mm. wide, the uppermost much reduced, acute, pilose or papillose on the lower surface, papillose or nearly glabrous on the upper; racemes 2–4, 2.2–4 cm. long, ascending or spreading, the rachis narrowly winged, about 0.8 mm. wide, terminated by a spikelet; spikelets 1.6 mm. long, solitary, narrowly obovate, subacute, glabrous, the glume and sterile lemma somewhat exceeding the fruit, the sterile lemma obscurely cross-wrinkled; fruit 1.5 mm. long, pale.

Marshy thickets, Panama.

PANAMÁ: Juan Díaz, *Standley 30543* (TYPE).

22. PASPALUM MICROSTACHYUM Presl, Rel. Haenk. 1:215. 1830.

Paspalum effusum Nees, Jour. Bot. Kew Misc. 2:104. 1850. Not *P. effusum* Rasp., 1825.
Paspalum cognatissimum Steud. Syn. Pl. Glum. 1:18. 1854.

Annual; culms slender, 20–135 cm. high, erect from a geniculate base, sometimes rooting at the lower nodes, branching at the lower and middle nodes; sheaths mostly much shorter than the internodes, keeled, glabrous to papillose-pilose; ligule about 0.3 mm. long; blades 3–30 cm. long, 6–20 mm. wide, thin, the lower tapering to a narrow base, the upper ones rounded to cordate, glabrous to papillose-pilose on both surfaces, the margins scabrous, papillose-ciliate toward the base; panicles terminal and axillary, composed of 6–35 slender, solitary or fascicled, ascending or arcuate-spreading racemes, the lower ones 3–8 cm. long, rather distant, the upper ones gradually approximate and shorter; rachis narrowly winged, 0.5–0.6 mm. wide, with scattered long white hairs on the margins; spikelets 1.5–1.6 mm. long, paired, on long slender pedicels, elliptic, subacute, the glume and sterile lemma equal, thin, softly and rather densely pubescent; fruit 1.5 mm. long, smooth and shining.

Moist thickets, roadsides, and waste places, Guatemala to Ecuador and Brazil.

BOCAS DEL TORO: Peach Creek, *von Wedel 2694.* CHIRIQUÍ: David, *Hitchcock 8348.* CANAL ZONE: Gamboa, *Pittier 4436;* Culebra, *Hitchcock 8025;* Las Cruces Trail, *Standley 29142;* Ancón, *Killip 4006;* Balboa, *Standley 25292, 26105; Hitchcock 8011.* PANAMÁ: Matías Hernández, *Pittier 6789;* Chepo, *Pittier 4462;* Chorrera, *Hitchcock 8151;* Taboga Island, *Hitchcock 8069; Standley 27083.*

23. PASPALUM ORBICULATUM Poir. in Lam. Encycl. 5:32. 1804.

Paspalum pusillum Vent. ex Flügge, Monogr. Pasp. 100. 1810.
Paspalum serpens Presl ex Trin. Gram. Pan. 102. 1826.
Paspalum geniculatum Steud. Syn. Pl. Glum. 1:18. 1854. Not *P. geniculatum* Raf., 1817.
Paspalum lenormandi Husn. Enum. Glum. 12. 1871.

Stoloniferous perennial; culms 10–60 cm. long, slender, creeping, rooting at the nodes, the ascending branches 10–25 cm. long, the internodes usually short, the nodes glabrous or appressed-pubescent; sheaths usually shorter than the internodes, compressed, glabrous, the margins ciliate toward the summit; blades 1–6 cm. long, 1.5–7 mm. wide, spreading, glabrous or minutely pubescent; racemes 2–7, approximate, ascending or spreading, 1–2, or rarely 3, cm. long, the rachis narrowly winged, 0.5–0.8 mm. wide, the peduncle included or short-exserted; spikelets 1–1.2 mm. long, ovoid, minutely pointed, glabrous or rarely pubescent, greenish-golden, the margins of the sterile lemma somewhat raised; fruit 0.9–1 mm. long, smooth and shining, chestnut-brown.

Moist sandy banks, open ground, and along streams and ditches, southern Mexico and the West Indies to Paraguay.

BOCAS DEL TORO: Laguna de Chiriquí, *Hart 92.* COLÓN: Fató, *Pittier 4147;* Catival, *Standley 30432.* CANAL ZONE: Frijoles, *Hitchcock 8389;* between Gorgona and Tabernilla, *Hitchcock 7966;* Bohio, *Pittier 3426.* PANAMÁ: Chepo, *Pittier 4613.*

24. PASPALUM JIMENEZII Chase, Contr. U. S. Nat. Herb. 28:159. *f. 101.* 1929.

Perennial; culms 10–30 cm. long, in small rather loose tufts, erect or decumbent at the base, rooting and branching at the lower nodes, the nodes glabrous or sparsely appressed-pubescent; sheaths compressed, hairy on the collar, the margins glabrous or ciliate, especially toward the summit; blades 2.5–9 cm. long, 2–5 mm.

wide, rounded at the base, glabrous or with a few hairs on the upper surface near the base; racemes 2–8, ascending or spreading, 1.5–5 cm. long, the rachis narrowly winged, about 0.8 mm. wide; spikelets 1.3–1.7 mm. long, elliptic or ovate-elliptic, subacute, glabrous, the glume and sterile lemma equal, pointed beyond the fruit, thin; fruit 1.1–1.5 mm. long, pale or brownish.

Sandy banks of rivers and streams, Costa Rica and Panama.

PANAMÁ: between Peluca Hydrographic Station and Quebrada Peluca along Río Boquerón, *Steyermark & Allen 17239*.

25. PASPALUM HITCHCOCKII Chase, Contr. U. S. Nat. Herb. 28:160. *f. 102*. 1929.

Perennial; culms 5–50 cm. long, creeping, rooting at the lower nodes, compressed, glabrous; the ascending branches 12–30 cm. high, nodes glabrous or appressed-pubescent; sheaths longer or shorter than the internodes, compressed, glabrous or with a few hairs at the throat; ligule membranaceous, about 0.3 mm. long; blades 5–13 cm. long, 4–9 mm. wide, flat, somewhat rounded at the base, glabrous; racemes 2–3, exserted or partly included, erect or ascending, rather thick, 1.5–4 cm. long, the rachis narrowly winged, 1–1.5 mm. wide, glabrous; spikelets 1.7–1.8 mm. long, depressed-hemispheric, the pedicels flat; glume and sterile lemma equal, thin, loose, irregularly wrinkled, glabrous; fruit about 1.6 mm. long, reddish-brown, smooth and shining.

Margins of lagoons and ponds, Panama and Colombia.

PANAMÁ: Chepo, *Pittier 4632*.

26. PASPALUM CONJUGATUM Bergius, Act. Helv. Phys. Math. 7:129. *pl. 8*. 1762.

Paspalum tenue Gaertn. f. Fruct. & Sem. 2:2. *pl. 80*. 1791.
Paspalum ciliatum Lam. Tabl. Encycl. 1:175. 1791.
Paspalum africanum Poir. in Lam. Encycl. Suppl. 4:314. 1816.
Paspalum renggeri Steud. Syn. Pl. Glum. 1:17. 1854.
Paspalum sieberianum Steud. Syn. Pl. Glum. 1:17. 1854.
Paspalum longissimum Hochst. ex Steud. Syn. Pl. Glum. 1:19. 1854.
Paspalum conjugatum var. *parviflorum* Doell in Mart. Fl. Bras. 2^2:55. 1877.
Paspalum conjugatum var. *tristachyum* Vandery. Bull. Agricol. Congo Belge 9:245. 1918.

Stoloniferous perennial; culms as much as 2 m. long, but usually less than 1 m., often decumbent at the base and rooting at the lower nodes, simple or sparingly branched; stolons long, leafy, with erect or ascending flowering branches, the nodes usually conspicuously pilose; culm sheaths loose, compressed, pubescent on the collar, the margins ciliate, those of the stolons short and broad; blades mostly 8–12 cm. long, 5–15 mm. wide, thin, glabrous or sometimes pubescent, the margins scabrous or short-ciliate; racemes 2, conjugate, widely spreading, 4–15 cm. long; spikelets 1.4–2.2 mm. long, ovate, minutely pointed, the margins of the glume papillose-ciliate with long fine hairs.

A common weed, roadsides, waste ground along rivers and ditches and in cultivated ground, Florida to Texas, Mexico and the West Indies to Argentina; also in the Eastern Hemisphere.

BOCAS DEL TORO: *Carleton 171*. CHIRIQUÍ: El Boquete, *Hitchcock 8193*. COLÓN: Río Indio de Fató, *Pittier 4260;* Porto Bello, *Pittier 2444, 2480*. SAN BLAS: Puerto Obaldía,

Pittier 4314. CANAL ZONE: Barro Colorado Island, *Bailey & Bailey 550, 646;* Culebra, *Hitchcock 7909; Pittier 2084, 3435, 3436;* Balboa, *Standley 25463, 25651.* PANAMÁ: Río La Maestra, *Allen 1.* DARIÉN: Boca de Cupe, *Allen 886.*

PASPALUM CONJUGATUM var. PUBESCENS Doell in Mart. Fl. Bras. 2^2:55. 1877.

Differs from the species in being usually stouter, with longer blades 15–25 cm. long, and larger spikelets 1.7–2.2 mm. long, the cilia more conspicuous than in the species.

Ditches, banks, and in waste ground, Mexico and the Lesser Antilles to Brazil. BOCAS DEL TORO: Laguna de Chiriquí, *Hart 81.*

27. PASPALUM FASCICULATUM Willd. ex Flügge, Monogr. Pasp. 69. 1810.

Paspalum vaginatum var. *pleostachyum* Doell in Mart. Fl. Bras. 2^2:75. 1877.
Paspalum fasciculatum var. *glabratus* Doell in Mart. Fl. Bras. 2^2:91. 1877.

Coarse stoloniferous perennial; culms as much as several meters long and 1 cm. thick, long decumbent-spreading, rooting at the lower nodes, usually forming tangled masses; stolons as much as 5 m. long with erect sparingly branching flowering culms 0.7–2 m. tall; nodes glabrous to densely bearded; sheaths rather loose, about as long as the relatively short internodes, nearly glabrous, the margins densely ciliate; ligule firm, about 0.7 mm. long; blades 20–60 cm. long, 1.2–3 cm. wide, acuminate, glabrous to sparsely papillose-pilose, the margins very scabrous; inflorescence flabellate, composed of 7–30 ascending to spreading racemes, 7–17 cm. long,

Fig. 21. *Paspalum fasciculatum*

aggregate on a rather short stout axis; spikelets 4–5 mm. long, solitary, imbricate, elliptic, abruptly acuminate, the first glume often developed; second glume and sterile lemma equal, pointed beyond the fruit, glabrous, or the margins usually silky-ciliate; fruit 3.7–3.8 mm. long, light brown, smooth and shining.

Margins of rivers and streams, swamps and low ground, southern Mexico to Ecuador and Argentina.

BOCAS DEL TORO: Changuinola Valley, *Dunlap 199.* CANAL ZONE: New Frijoles, *Pittier 6841;* between Frijoles and Monte Lirio, *Killip 12125;* Matachin, *Pittier 4435;* Trinidád River, *Pittier 4020;* Culebra, *Hitchcock 7899;* Juan Mina, *Bartlett & Lasser 16881;* Corozal, *Piper 5215.*

28. PASPALUM VIRGATUM L. Syst. Nat. ed. 10. 2:855. 1759.

Paspalus virgatus α. *linneanus* Flügge, Monogr. Pasp. 189. 1810.
Paspalus virgatus γ. *jacquinianus* Flügge, Monogr. Pasp. 190. 1810.
Paspalus virgatus δ. *willdenowianus* Flügge, Monogr. Pasp. 190. 1810.
Paspalum virgatum var. *stramineum* Griseb. Fl. Brit. W. Ind. 543. 1864.
Paspalum leucocheilum Wright, Anal. Acad. Cienc. Habana 8:203. 1871; Fl. Cub. 194. 1873.
Panicum lagascae var. *virgatum* (L.) Kuntze, Rev. Gen. Pl. 3³:362. 1898.

Coarse leafy perennial; culms in large dense clumps, 1–2 m. high, erect, simple; sheaths longer than the internodes, glabrous or sparsely hirsute on the collar and along the margins, the upper keeled, the lower ones spongy, reticulate, purplish; ligule 1.5–2 mm. long; blades 30–75 cm. long, 1–2 cm. wide, firm, flat, the margins serrulate; inflorescence 12–40 cm. long, composed of few to many thick ascending to drooping racemes, the lower ones mostly 10–15 cm. long, rarely 20 cm. long; rachis 1–1.5 mm. wide with a tuft of long hairs at the base, the margins very scabrous; spikelets 2.2–3 mm. long, paired, crowded, obovate, abruptly pointed, with silky hairs on the margins especially toward the summit, otherwise glabrous to pubescent; fruit 2–2.2 mm. long, chestnut-brown, striate.

Moist open ground and brushy slopes, Texas, Mexico, and the West Indies to Brazil.

CANAL ZONE: Ancón, *Pittier 6768; Standley 26338;* Obispo, *Standley 31784;* Gamboa, *Standley 28456;* Empire, *Piper 3724, 5199;* Culebra, *Hitchcock 7903; Pittier 2079;* Pedro Miguel, *Allen 7;* Madden Dam, *Bartlett & Lasser 16773;* Corozal, *Piper 5203; Standley 26882.* PANAMÁ: Arraiján, *Woodson, Allen & Seibert 1381;* Chepo, *Pittier 4647, 4693;* Taboga Island, *Hitchcock 8082; Pittier 3604.*

29. PASPALUM ACUTUM Chase, Jour. Washington Acad. Sci. 17:146. *f. 4.* 1927.

Perennial; culms 1–2 m. high, erect, simple, leafy to the summit; sheaths much longer than the internodes, compressed, papillose-hispid in the throat and on the margins toward the summit; ligule 1.5–2 mm. long; blades 35–75 cm. long, 14–18 mm. wide, the uppermost greatly reduced, narrowed toward the base, acuminate, glabrous on the lower surface, sparsely pubescent or pilose on the upper, the margins sharply serrate; panicle scarcely exserted, composed of 6–10 heavy ascending or drooping racemes 8–12 cm. long, the axis 5–15 cm. long; rachis 1–1.5 mm. wide with a tuft of long hairs at the base, the margins serrate; spikelets 3.5–3.9 mm. long, paired, closely imbricate, abruptly acute; glume and sterile lemma equal,

pointed beyond the fruit, the glume obscurely to rather prominently silky-ciliate toward the summit, otherwise glabrous or obscurely pubescent, the sterile lemma glabrous; fruit 3 mm. long, elliptic, pale, minutely striate.

Low open ground and along ditches, Mexico (Veracruz) and Panama to northern Brazil.

CANAL ZONE: Ancón, *Killip 4003* (TYPE).

30. PASPALUM DENSUM Poir. in Lam. Encycl. 5:32. 1804.

Paspalum paniceum Smith in Rees' Cycl. 26: no. 14. 1813.

Perennial; culms 0.8–2 m. high, robust, thick and succulent at the base, compressed, the nodes glabrous to densely appressed-hirsute; sheaths much longer than the internodes, keeled, broad and loose, glabrous or hirsute on the collar, the margins sometimes ciliate toward the summit, the lower ones equitant, purplish, spongy, reticulate in drying; ligule 1.5–3 mm. long; blades 50–100 cm. long, 1–2 cm. wide, firm, folded at the base, long-acuminate, glabrous with a few hairs just above the ligule, the margins sharply serrate; panicles 12–40 cm. long, rather narrow, tapering, dense, composed of 50–100 crowded, finally spreading racemes, the lower ones 5–9 cm. long with conspicuous tufts of hairs in the axils; rachis 1.2–1.5 mm. wide, sharply serrate, the margins papillose-ciliate with rather stiff hairs 2–5 mm. long; spikelets 1.9–2.2 mm. long, paired, on slender scabrous pedicels, suborbicular or obovate, sometimes tinged with purple; glume and sterile lemma equal, thin, glabrous; fruit covered or slightly exposed, 1.8 mm. long, pale, minutely striate.

Marshes, wet savannas and wet open ground, the West Indies and Panama to Bolivia and Brazil.

COCLÉ: between Aguadulce and Antón, *Woodson, Allen & Seibert 1213*. CANAL ZONE: Fort Kobe road, *Woodson, Allen & Seibert 1422;* Corozal, *Killip 4106;* Balboa, *Hitchcock 8020*. PANAMÁ: Chepo, *Pittier 4646*.

31. PASPALUM CORYPHAEUM Trin. Gram. Pan. 114. 1826.

Paspalum pruinosum Trin. Gram. Icon. 3: *pl. 272*. 1836.
Paspalum familiare Steud. Syn. Pl. Glum 1:24. 1854.
Paspalum violascens Mez, Repert. Sp. Nov. (Fedde) 15:73. 1917.

Perennial; culms in tough clumps from short hard rhizomes, 1–4 m. high, slender or robust, glabrous to densely papillose-hispid at least below the glabrous to conspicuously bearded nodes, finally branching, the branches slender, leaning or drooping; sheaths mostly longer than the internodes, the lower ones usually papillose-hispid, the upper ones glabrous or only sparsely papillose-hispid, the margins sometimes ciliate toward the summit; ligule firm, 1–3 mm. long; blades 12–32 cm. long, 8–23 mm. wide, rounded at the base, glabrous or scaberulous, sometimes sparsely pubescent or pilose with a dense line of long hairs just above the ligule, the margins scabrous; panicles nodding or drooping, composed of 10–45 racemes spreading or recurved at maturity, the lower 6–14 cm. long, the axis 10–25 cm. long, glabrous or sparsely pilose; rachis about 0.5 mm. wide, scabrous, densely hairy in the axils, sometimes naked at the base; spikelets 2–2.5 mm. long, elliptic,

paired, usually loosely arranged toward the base of the racemes, denser above; glume and sterile lemma equal, scarcely covering the fruit, finely pubescent or especially the lemma nearly glabrous; fruit pale, shining, very minutely striate.

Savannas, brushy slopes, river banks, and wood borders, Panama and Trinidad to Brazil.

PANAMÁ: Chagres Valley, *Pittier 3478*.

32. PASPALUM PLICATULUM Michx. Fl. Bor. Amer. 1:45. 1803.
Paspalum undulatum Poir. in Lam. Encycl. 5:29. 1804.
Paspalum lenticulare H.B.K. Nov. Gen. & Sp. 1:92. 1815.
Paspalum gracile LeConte, Jour. de Phys. Chym. 91:285. 1820. Not *P. gracile* Rudge, 1805.
Paspalus leptos Schult. Mant. 2: 173. 1824.
Paspalum montevidense Spreng. Syst. Veg. 1:246. 1825.
Paspalum tenue Kunth, Rév. Gram. 1:26. 1829. Not *P. tenue* Gaertn., 1791.
Paspalum multiflorum Desv. Opusc. 58. 1831.
Paspalum orthos Schult. ex Kunth, Enum. Pl. 1:57. 1833.
Paspalum marginatum Spreng. in Steud. Nom. Bot. ed. 2. 2:272. 1841, as synonym of *P. undulatum* Poir. Not *P. marginatum* Trin., 1826.
Panicum campestre Schlecht. Linnaea 26:131. 1853. Not *P. campestre* Trin., 1834.
Paspalum atrocarpum Steud. Syn. Pl. Glum. 1:25. 1854.
Paspalum antillense Husn. Bull. Soc. Linn. Normand. II. 5:260. 1871.
Paspalum saxatile Salzm. ex Doell in Mart. Fl. Bras. 2^2:76. 1877.
Paspalum decumbens Sagot ex Doell in Mart. Fl. Bras. 2^2:77. 1877. Not *P. decumbens* Swartz, 1788.
Paspalum plicatulum var. *intumescens* Doell in Mart. Fl. Bras. 2^2:78. 1877.
Paspalum pauperculum Fourn. Mex. Pl. 2:10. 1886.
Paspalum pauperculum var. *altius* Fourn. Mex. Pl. 2:10. 1886.
Panicum plicatulum Kuntze, Rev. Gen. Pl. 3^3:363. 1898.

Perennial; culms in small tufts, mostly 0.5-1 m. high, erect or ascending, simple or sparingly branched, glabrous; sheaths longer than the internodes, keeled, glabrous or sparsely papillose-pilose; ligule 2–3 mm. long, brown, truncate; blades as much as 50 cm. long, 3–10 mm. wide, firm, flat or folded, glabrous or sparsely papillose-pilose on the upper surface, especially along the margins; racemes few to several, usually arcuate-spreading, 2–10 cm. long with a tuft of long hairs at the base, these sometimes nearly wanting; spikelets 2.5–2.8 mm. long, paired, glabrous or appressed-pubescent, the sterile lemma cross-wrinkled near the margins; fruit dark brown, smooth and shining.

Moist open ground or wood borders, mostly in clay or sandy soil, southern United States and the West Indies to Argentina.

CHIRIQUÍ: El Boquete, *Hitchcock 8190, 8292, 8293;* Dolega, *Hitchcock 8339½.* COCLÉ: Aguadulce, *Pittier 4914;* El Valle, *Bartlett & Lasser 16653.* CANAL ZONE: Fort Randolph, *Maxon & Harvey 6514; Standley 28600;* Gatún, *Piper 5198; Hitchcock 7969; 7981;* Empire, *Pittier 3725;* Culebra, *Hitchcock 7902, 8024;* Summit, *Standley 30000;* Madden Dam, *Bartlett & Lasser 16799;* between Pedro Miguel and Corozal, *Hitchcock 7991;* between Corozal and Ancón, *Pittier 6731;* Corozal, *Piper 5206; Killip 4099;* Ancón, Hill, *Killip 4012, 4031; Greenman & Greenman 5138;* Ancón, *Killip 4116;* Balboa, *Standley 25265, 26113, 32090; Hitchcock 7995, 8010.* PANAMÁ: Chivi-Chivi Trail, *Piper 5198½;* Matías Hernández, *Standley 28979;* Las Sabanas, *Pittier 6763; Standley 25901;* Panamá, *Standley 26874, 29705;* Taboga Island, *Pittier 3622;* Chorrera, *Hitchcock 8124, 8138;* Chepo, *Pittier 4494, 4551, 4742, 4648;* Aguarubia, *Killip 4280.*

33. PASPALUM CENTRALE Chase, Jour. Washington Acad. Sci. 17:145. *f. 2.* 1927.

Perennial; culms 15–60 cm. long, in small spreading tufts, ascending or spreading, sometimes rooting at the lower nodes, usually branching; sheaths longer than the internodes, loose, sparsely to densely papillose-pilose; ligule 2–3 mm. long, brown; blades 5–25 cm. long, 3–10 mm. wide, the uppermost reduced, flat, acuminate, pilose or papillose-pilose, sometimes sparsely so, especially on the lower surface; racemes 2–6, 2–7 cm. long, ascending or spreading, often arcuate, the rachis 1–1.3 mm. wide, the margins scabrous, with a tuft of long hairs in the axils; spikelets 2–2.3 mm. long, solitary, elliptic or obovate, glabrous or rarely pubescent; fruit dark brown at maturity, shining, minutely striate.

Along ditches and in moist open ground, El Salvador to Panama.

CHIRIQUÍ: David, *Hitchcock 8345.* COCLÉ: El Valle de Antón, *Allen 2824.* CANAL ZONE: Pedro Miguel, *Allen 6;* Culebra, *Hitchcock 7985, 8059;* Madden Dam, *Bartlett & Lasser 16797;* Balboa, *Hitchcock 8004, 8005, 8008.* PANAMÁ: Chivi Chivi, *Killip 4077;* Las Sabanas, *Pittier 6817;* Matías Hernández, *Pittier 6760, 6779;* Panamá, *Standley 26796, 27782;* Río Tecúmen, *Standley 29397;* Chepo, *Pittier 4527, 4621;* Nuevo San Francisco, *Standley 30752.*

34. PASPALUM CONVEXUM Humb. & Bonpl. in Flügge, Monogr. Pasp. 175. 1810.

Paspalum villifolium Steud. Syn. Pl. Glum. 1:20. 1854.
Paspalum ancylocarpum Nees ex Steud. Syn. Pl. Glum. 1:27. 1854.
Paspalum hemicryptum Wright, Anal. Acad. Cienc. Habana 8:204. 1871; Wright & Sauv. Fl. Cub. 196. 1873.
Paspalum inops Vasey, Contr. U. S. Nat. Herb. 1:281. 1893.
Paspalum inops var. *major* Vasey in Beal, Grasses N. Amer. 2:89. 1896.

Annual; culms 10–75 cm., usually 20–40 cm., high, erect or ascending, sometimes widely spreading, branching from the lower and middle nodes; sheaths compressed, keeled, longer than the internodes in small plants, shorter than the internodes on taller plants, from glabrous to conspicuously papillose-pilose; ligule about 2 mm. long, brown, fragile; blades 5–23 cm. long, 3–11 mm. wide, the uppermost sometimes reduced, somewhat clasping at the base, conspicuously papillose-pilose throughout or only toward the base; racemes 1–4, erect to spreading at maturity, 1.5–7 cm. long, the rachis 1–2 mm. wide, long-pilose at the base; spikelets 2.2–3 mm. long, paired, broadly obovate, glabrous or appressed-pubescent; fruit dark brown, shining, minutely striate.

Open ground, cultivated and waste places, northern Mexico to Brazil; Cuba and Trinidad, probably introduced.

CHIRIQUÍ: Dolega, *Hitchcock 8332;* David, *Hitchcock 8369.* COCLÉ: Aguadulce, *Pittier 4959;* El Valle, *Bartlett & Lasser 16652.*

35. PASPALUM BOSCIANUM Flügge, Monogr. Pasp. 170. 1810.

Paspalum virgatum Walt. Fl. Carol. 75. 1788. Not *P. virgatum* L., 1759.
Paspalum purpurascens Ell. Bot. S. C. & Ga. 1:108. *pl. 6. f. 3.* 1816.
Paspalum confertum LeConte, Jour. de Phys. Chym. 91:285. 1820.
Paspalum virgatum var. *purpurascens* Wood, Class-book. ed. 3. 781. 1861.

Annual; culms 20–100 cm. high, ascending or spreading, branching, sometimes rooting at the lower nodes, glabrous; sheaths compressed, keeled, longer than

the internodes, glabrous or the lowermost rarely pilose; ligule 2–3.5 mm. long, brown; blades 10–40 cm. long, mostly 15–30 cm., 6–18 mm. wide, glabrous or papillose-pilose on the upper surface toward the base, the margins very scabrous; racemes 2–15, rarely solitary in depauperate plants, 2.5–9 cm. long, ascending or finally spreading, somewhat arcuate, the rachis 2–2.5 mm. wide, scabrous on the margins, usually with a tuft of long hairs at the base; spikelets 2–2.2 mm. long, paired, crowded, obovate to suborbicular, glabrous, rusty brown at maturity, the glume and sterile lemma equal, barely covering the fruit, fragile, not wrinkled; fruit dark brown, shining, minutely papillose-striate.

Moist or wet open ground and waste places, sometimes a weed in cultivated fields, Virginia to Florida and Louisiana; Guatemala, Panama, Puerto Rico, and northern Brazil.

CHIRIQUÍ: David, *Hitchcock 8359*. PANAMÁ: Chivi Chivi, *Killip 4084*.

36. PASPALUM MELANOSPERMUM Desv. in Poir. in Lam. Encycl. Suppl. 4:315. 1816.

Paspalum humile Steud. Syn. Pl. Glum. 1:25. 1854.
Paspalum plicatulum var. *microspermum* Doell in Mart. Fl. Bras. 2^2:78. 1877.
Paspalum olivaceum Hitchc. & Chase, Contr. U. S. Nat. Herb. 18:310. 1917.

Leafy annual, usually tinged with purple; culms erect or decumbent at the base, sometimes rooting at the lower nodes, 40–70 cm. high, glabrous; sheaths loose, thin, compressed, keeled, glabrous; ligule 1.5–2 mm. long; blades commonly 10–15 cm. long, 5–10 mm. wide, sparsely pilose on the upper surface at the base; panicle short-exserted from the upper bladeless sheath, 4–8 cm. long, the axis more or less flexuous; racemes 2–7, arcuate-spreading, 1–6 cm. long, the rachis about 1 mm. wide with a few long hairs at the base; spikelets 2 mm. long, obovate, strongly convex on the back; second glume and sterile lemma equal, thin, glabrous or nearly so, the lemma often minutely wrinkled inside the margin; fruit hemispherical, dark brown, shining.

Open, usually moist ground, Guadeloupe, Martinique, and Panama to Bolivia and Brazil.

CANAL ZONE: vicinity of Madden Dam, on limestone outcrops, *Bartlett & Lasser 16802*.

37. PASPALUM GARDNERIANUM Nees, Jour. Bot. Kew Misc. 2:103. 1850.

Paspalum gardnerianum var. *oligostachyum* Doell in Mart. Fl. Bras. 2^2:42. 1877.
Paspalum gardnerianum var. *vestitum* Kuhlm. Comm. Linhas Telegr. Matto Grosso 67:49. 1922.

Perennial; culms slender, 50–110 cm. high, in small dense rather tough tufts, erect from hard, somewhat enlarged, densely woolly bases, simple or sometimes rather freely branching from the lower or middle nodes, glabrous or the lower nodes appressed-pubescent; sheaths longer than the internodes, sparsely to densely papillose-pilose with rather stiff hairs, the upper ones glabrous or nearly so; ligule less than 0.5 mm. long; blades 5–35 cm. long, 3–8 mm. wide, erect to spreading, flat or drying involute toward the tip, from glabrous to puberulent and rather

conspicuously papillose-pilose; racemes 1–10, mostly 3–5, erect to arcuate-spreading, rather remote on a slender axis, the lower ones 2.5–10 cm. long, the rachis about 1 mm. wide, densely pilose at the base; spikelets 1.6–1.9 mm. long, obovate-elliptic, paired, crowded, the short pedicels bearing a tuft of stiff golden hairs which exceed the spikelets; glume wanting, the sterile lemma as long as the fruit, glabrous or sparsely pubescent; fruit chestnut-brown, strongly papillose-striate, the margins of the lemma pale and smooth.

Sandy savannas and rocky slopes, Panama to Argentina.

COCLÉ: Natá, *Allen 847*. PANAMÁ: Chorrera, *Hitchcock 8169*.

38. PASPALUM FIMBRIATUM H.B.K. Nov. Gen. & Sp. 1:93. *pl. 28*. 1815.

Annual; culms 25–100 cm. high, erect or ascending, branching from the lower and sometimes the middle nodes, glabrous; sheaths much longer than the internodes or the upper ones shorter, compressed, keeled, glabrous, or sparsely papillose-pilose, especially along the margins; ligule 0.5–2 mm. long, thin, brown; blades 5–40 cm. long, 5–12 mm. wide, thin, flat, acuminate, slightly rounded at the base, glabrous or papillose-pilose on the upper surface toward the base, the margins scabrous, mostly rather prominently papillose-ciliate; racemes 2–8, 2.5–8 cm. long, ascending or spreading, somewhat distant on the flattened axis, the rachis narrowly winged, about 1.5 mm. wide with a tuft of long hairs at the base; spikelets 2.2–2.3 mm. long, 3 mm. wide including the winged margins, paired, crowded; glume broadly ovate, apiculate, papillose, the margins with a broad, conspicuous, irregularly notched, stiffly ciliate wing; sterile lemma a little shorter than the glume, obtuse, apiculate, the midnerve strong, the margins winged like the glume or usually only partially winged, sometimes wingless; fruit 2 mm. long, pale, ovate, minutely roughened, the nerves evident.

Moist ground, savannas, waste places, and open fields, the West Indies and Panama to Colombia and northern Brazil; introduced in the Hawaiian Islands.

CANAL ZONE: France Field, *Standley 28583*.

39. PASPALUM SACCHAROIDES Nees in Trin. Gram. Icon. 1: *pl. 107*. 1828.

Saccharum polystachyum Swartz, Prodr. Veg. Ind. Occ. 21. 1788. Not *Paspalum polystachyum* R. Br., 1810.
Panicum saccharoides Kunth, Rév. Gram. 2:237. *pl. 30*. 1830.
Tricholaena saccharoides Griseb. Syst. Unt. Veg. Karaib. 117. 1857.
Paspalum polystachyum Kuntze, Rev. Gen. Pl. 2:786. 1891. Not *P. polystachyum* R. Br., 1810.

Perennial; culms 1–2 m. high in coarse tough clumps, ascending or suberect, often decumbent or creeping at the base; sheaths longer than the internodes, glabrous or papillose-pilose, sometimes papillose only, the margins densely silky-ciliate with long soft hairs; ligule a very short obscure firm membrane; blades 15–30 cm. long, 8–15 mm. wide, spreading, tapering to a rather fine involute tip, finely pilose or papillose on the upper surface, the lower surface and margins glabrous; inflorescence dense, flabellate, feathery, composed of 30–50 slender drooping racemes 15–30 cm. long, crowded on a short axis; rachis about 0.6 mm. wide,

often naked toward the base with a dense tuft of long hairs in the axils; spikelets 2.5–3 mm. long, relatively distant, lanceolate, acuminate, solitary; glume and sterile lemma thin, the glume sparsely pubescent on the back, fringed with pale silky hairs, 5–8 mm. long, the sterile lemma shorter than the glume, glabrous; fruit about 1.9 mm. long, acute, pale, smooth, only slightly indurate.

Open, brushy, or wooded slopes, Costa Rica and the Lesser Antilles to Bolivia.

CANAL ZONE: Toro Point, *Hitchcock 8045;* Barro Colorado Island, *Bailey & Bailey 38; Kenoyer 112; Shattuck 303;* between Las Cascadas and Bas Obispo, *Pittier 3745;* Culebra, *Hitchcock 7904.*

53. PANICUM L.

PANICUM L. Sp. Pl. 55. 1753.

Spikelets paniculate or sometimes short-pedicelled in one-sided racemes; first glume minute to nearly as long as the spikelet; second glume and sterile lemma nearly equal, similar, the lemma often enclosing a hyaline palea and sometimes a staminate flower; fertile floret indurate, the nerves obsolete, the margins of the lemma inrolled, firmly enclosing the palea.

Annuals or perennials, exceedingly variable in habit, size, and appearance.

a. Basal blades distinctly different from the culm blades, forming winter rosettes; culms at first simple, finally sparingly to freely branching.
  b. Plants light green, the blades of the rosette forming small soft dense cushions; culms 10–20 cm. high, branching from the base; blades conspicuously ciliate ..... 1. P. STRIGOSUM
  bb. Plants dark green or olivaceous, the basal blades not forming dense soft cushions; culms 20–100 cm. high, branching from the middle and upper nodes; blades not conspicuously ciliate or only near the base.
    c. Ligule obsolete or nearly so; blades glabrous or nearly so with firm, white margins, ciliate near the base; culms sparingly branching ..... 2. P. SPHAEROCARPON
    cc. Ligule 2–4 mm. long, ciliate; blades densely pubescent or villous; culms finally freely branching, the blades and panicles of the branches reduced.
      d. Blades velvety-pubescent; spikelets 1.8–1.9 mm. long; culms mostly more than 70 cm. long from a creeping base ..... 3. P. VISCIDELLUM
      dd. Blades not velvety; spikelets 1.9–2 mm. long; culms less than 50 cm. long ..... 4. P. OLIVACEUM
aa. Basal blades similar to the culm blades.
  b. Plants annual.
    c. Fruit transversely rugose; spikelets short-pedicelled along the raceme-like branches.
      d. Spikelets glabrous, brown, 2.5–3 mm. long ..... 7. P. FASCICULATUM
      dd. Spikelets densely pubescent, 3.5–4 mm. long ..... 8. P. MOLLE
    cc. Fruit smooth; spikelets in open panicles.
      d. First glume one-fourth as long as the spikelet, obtuse or subacute. Glabrous, rather succulent, subaquatic annual ..... 9. P. CHLOROTICUM
      dd. First glume at least half as long as the spikelet.
        e. Culms erect; spikelets at least 2 mm. long; blades elongate.
          f. Culms robust, 1.5 m. or more high; spikelets 2 mm. long 12. P. HIRSUTUM
          ff. Culms slender, not more than 75 cm. high.
            g. Spikelets 2.2 mm. long; panicles terminal and axillary, crowded, implicate ..... 11. P. CAYENNENSE
            gg. Spikelets 2.5–3.3 mm. long; panicles not implicate ..... 10. P. HIRTICAULE
        ee. Culms decumbent-spreading; spikelets 1.5 mm. long; blades ovate or elliptic.

f. Panicles 2–5 cm. long, with delicate flexuous, spreading or reflexed branches; spikelets pyriform, glabrous ..... 25. P. PYRULARIUM
ff. Panicles 5–20 cm. long, the branches delicate but not flexuous, ascending to spreading; spikelets elliptic, pubescent ..... 27. P. TRICHOIDES
bb. Plants perennial.
c. Spikelets short-pedicellate along one side of the panicle branches, forming spike-like or 1-sided racemes.
d. Fruit transversely rugose.
e. Culms slender, less than 1 m. long; nodes glabrous ..... 5. P. GEMINATUM
ee. Culms coarse, as much as 6 m. long; nodes bearded ..... 6. P. PURPURASCENS
dd. Fruit smooth, not rugose.
e. Blades lanceolate or ovate-lanceolate.
f. Spikelets sparsely pilose, the sterile lemma with two crateriform glands on the back ..... 16. P. PULCHELLUM
ff. Spikelets glabrous, glandless.
g. Blades 1–5 cm. long; racemes few to several, scarcely crowded ..... 17. P. STOLONIFERUM
gg. Blades 5–11 cm. long; racemes numerous, crowded ..... 18. P. FRONDESCENS
ee. Blades linear, often elongate, frequently cordate at the base.
f. Spikelets nearly sessile, densely arranged along one side of the pilose rachis.
g. Culms as much as 2 m. high; panicles 25–45 cm. long 19. P. MILLEFLORUM
gg. Culms not more than 1 m. high; panicles 5–15 cm. long. 20. P. PILOSUM
ff. Spikelets in part on short branchlets on the lower side of the rachis.
g. Blades 20–25 cm. long, 1.5–3 cm. wide; panicles 20–40 cm. long ..... 24. P. STAGNATILE
gg. Blades not more than 15 cm. long; panicles 5–30 cm. long.
h. Nodes pubescent ..... 21. P. POLYGONATUM
hh. Nodes glabrous.
i. Blades narrowed toward the base ..... 22. P. LAXUM
ii. Blades somewhat cordate at the base ..... 23. P. BOLIVIENSE
cc. Spikelets in open or contracted panicles but not on 1-sided racemes.
d. Fruit transversely rugose. Culms in large coarse clumps ..... 36. P. MAXIMUM
dd. Fruit not rugose.
e. First glume much less than one-fourth as long as the spikelet.
f. Sheaths glabrous on the back, densely pubescent on the collar; panicles mostly 4–8 cm. long; blades 5–12 mm. wide 30. P. ARUNDINARIAE
ff. Sheaths pilose or papillose-pilose; panicles 10–15 cm. long; blades 1–2.5 cm. wide ..... 31. P. SCHIFFNERI
ee. First glume more than one-fourth as long as the spikelet.
f. Blades as much as 1 m. long and 6 cm. wide ..... 38. P. GRANDE
ff. Blades much smaller.
g. Fruit crested at the apex. Spikelets 5.5–6 mm. long ..... 39. P. ZIZANIOIDES
gg. Fruit not crested.
h. Panicles narrow and few-flowered. Culms erect, wiry .. 34. P. STENODOIDES
hh. Panicles many-flowered.
i. Panicles 40–60 cm. long, the elongate branches in verticils ..... 37. P. MERTENSII
ii. Panicles not more than 30 cm. long, the branches not in verticils.
j. First glume blunt or rounded, seldom subacute, two-thirds as long as the spikelet or more.
k. Spikelets 2 mm. long; panicles all alike, 10–20 cm. long ..... 29. P. SELLOWII
kk. Spikelets 2.7–3.5 mm. long; primary panicles open, the secondary narrow, reduced, partly enclosed in the sheath.
l. Plant glabrous or the blades sparsely pilose .. 32. P. CORDOVENSE
ll. Plants velvety pubescent ..... 33. P. PANTRICHUM
jj. First glume acute or acuminate, not more, usually less, than two-thirds as long as the spikelet.

k. Spikelets 1.2–1.5 mm. long, the first glume one-fifth as long as the spikelet ..... 28. P. TRICHANTHUM
kk. Spikelets 2.3–4 mm. long.
l. Culms erect, or finally spreading.
m. Spikelets glabrous.
n. Spikelets 3 mm. long; sheaths prominently papillose-hispid ..... 13. P. GHIESBREGHTII
nn. Spikelets 3.5–4 mm. long; sheaths glabrous ..... 14. P. RIGIDUM
m. Spikelets sparsely hispid. Panicles terminal and axillary, implicate, partly enclosed in the sheath ..... 15. P. RUDGEI
ll. Culms straggling.
m. Culms coarse and stout, 2–4 m. long; spikelets 3.2–4 mm. long, glabrous, turgid, gaping; first glume about two-thirds as long as the spikelet ..... 35. P. ALTUM
mm. Culms slender, mostly about 1 m. long; spikelets 2.3–2.5 mm. long, sparsely pilose; first glume about half as long as the spikelet ..... 26. P. HAENKEANUM

1. PANICUM STRIGOSUM Muhl. ex Ell. Bot. S. C. & Ga. 1:126. 1816.

Panicum laxiflorum var. *pubescens* Vasey, Contr. U. S. Nat. Herb. 3:30. 1892.
Panicum longipedunculatum Scribn. Bull. Tenn. Exp. Sta. 7:53. 1894.

Perennial; culms in dense soft spreading tufts, mostly 10–20 cm. high; sheaths glabrous, the margins ciliate; blades 2–5 cm. long, 3–6 mm. wide, thin, light green, sparsely pilose on the upper surface, conspicuously papillose-ciliate on the margins; panicles 2–5 cm. long, the axis pilose, the branches stiffly ascending or spreading; spikelets 1.3–1.5 mm. long, glabrous, the first glume one-third to half as long as the spikelet; fruit 1.3 mm. long.

Woods and dry rocky slopes, southeastern United States, Mexico, and the West Indies to Colombia.

COCLÉ: El Valle, *Allen 772*. CANAL ZONE: Ancón Hill, *Killip 4020*. PANAMÁ: Hacienda La Joya, *Dodge, Hunter, Steyermark & Allen 16884*.

2. PANICUM SPHAEROCARPON Ell. Bot. S. C. & Ga. 1:125. 1816.

Panicum kalmii Swartz, Adnot. Bot. 6. 1829.
Panicum dichotomum γ. *sphaerocarpum* Wood, Class-book. ed. 3. 786. 1861.
Panicum nitidum var. *crassifolium* A. Gray ex Doell in Mart. Fl. Bras. 2^2:247. 1877.
Panicum microcarpon var. *sphaerocarpon* Vasey, Grasses U. S. 12. 1883.

Perennial; culms 20–55 cm. high, in small tufts, erect or spreading, the nodes appressed-pubescent; sheaths usually longer than the internodes, the margins ciliate, otherwise glabrous, often viscid between the nerves, especially toward the summit; ligule very short or obsolete; blades 4–10 cm. long, 5–15 mm. wide, cordate, the white cartilaginous margins papillose-ciliate toward the base; panicles 5–10 cm. long, long-exserted, loosely flowered, the axis, branches and pedicels viscid; spikelets subspherical, 1.6–1.8 mm. long, pubescent, or sometimes nearly glabrous; fruit 1.4–1.5 mm. long. Autumnal phase sparingly branched, spreading, the blades and panicles not much reduced.

Sandy or gravelly banks, roadsides and open woods, eastern United States, Mexico, and Cuba to Venezuela.

CHIRIQUÍ: El Boquete, *Hitchcock 8172, 8343.*

3. PANICUM VISCIDELLUM Scribn. U. S. Dept. Agr. Div. Agrost. Circ. 19:2. 1900.
Panicum reflexopilum Steud. Syn. Pl. Glum. 1:84. 1854.

Perennial; culms 30–100 cm. long, ascending from a decumbent, widely spreading or creeping base, simple at first but finally rather freely branching, softly villous or nearly glabrous, the nodes usually bearded; sheaths mostly shorter than the internodes, pilose or papillose-pilose, sometimes nearly glabrous; ligule densely ciliate, 2–4 mm. long; blades 5–13 cm. long, 9–13 mm. wide, lanceolate, subcordate, softly pubescent or villous on both surfaces; panicles 4–11 cm. long, rather densely flowered, the branches ascending, spreading, or even reflexed, the branchlets and pedicels spreading, implicate; spikelets 1.8–1.9 mm. long, sparsely pubescent or nearly glabrous; first glume about one-third as long as the spikelet, subacute; second glume and sterile lemma rather strongly nerved, slightly exceeding the fruit; fruit 1.5 mm. long, abruptly pointed.

Dry fields, open forests and grassy banks, southern Mexico to Colombia and Brazil.

CHIRIQUÍ: El Boquete, *Killip 4565; Pittier 3043; Hitchcock 8178.*

4. PANICUM OLIVACEUM Hitchc. & Chase, Contr. U. S. Nat. Herb. 15:225. *f. 234.* 1910.

Perennial; culms 20–40 cm. high, erect or spreading at the base, softly appressed-villous, the nodes bearded; sheaths mostly shorter than the internodes, velvety pilose with spreading hairs; ligule ciliate, 3–4 mm. long; blades 4–7 cm. long, 5–8 mm. wide, the uppermost reduced, stiffly ascending or spreading, rather densely softly pubescent on the lower surface, pubescent or villous on the upper, the margins scabrous; panicles 3–7 cm. long, the axis pilose; spikelets 1.9–2 mm. long, pubescent, the first glume subacute, one-fourth to one-third as long as the spikelet; fruit 1.6 mm. long. Autumnal phase decumbent-spreading, freely branching from the upper and middle nodes, the reduced branches appressed, the blades 1–2 cm. long, 2–4 mm. wide.

Fields, open woods, open or brushy banks and roadsides, southern Mexico to Venezuela.

CHIRIQUÍ: El Boquete, *Maxon 5136; Hitchcock 8189, 8252, 8280; Killip 4525a, 4526, 4556, 4560, 4563.*

5. PANICUM GEMINATUM Forsk. Fl. Aegypt. Arab. 18. 1775.
Paspalum appressum Lam. Tabl. Encycl. 1:176. 1791.
Digitaria appressa Pers. Syn. Pl. 1:85. 1805.
Panicum beckmanniaeforme Mikan ex Trin. in Spreng. Neu. Entd. 2:83. 1821.
Panicum truncatum Trin. Gram. Pan. 130. 1826.
Panicum brizaeforme Presl, Rel. Haenk. 1:302. 1830.
Panicum carnosum Salzm. ex Steud. Syn. Pl. Glum. 1:60. 1854.

Panicum glomeratum Buckl. Prel. Rep. Geol. Agr. Surv. Tex. App. 3. 1866.
Panicum appressum Lam. ex Doell in Mart. Fl. Bras. 2^2:184. 1877.
Paspalidium geminatum Stapf in Prain, Fl. Trop. Afr. 9:583. 1920.

Perennial; culms cespitose, spreading from a decumbent base, 25–85 cm. long, succulent at least toward the base, smooth, shining; sheaths longer than the internodes, more or less inflated; ligule ciliate, about 1 mm. long; blades 10–20 cm. long, 3–6 mm. wide, flat or loosely rolled, glabrous on the lower surface, scaberulous on the upper, the margins glabrous or scabrous; panicle 12–30 cm. long with 12–18 rather short erect or ascending racemes; spikelets 2–2.5 mm. long, about 1.5 mm. wide, acute, the first glume 0.5 mm. long, clasping, truncate; fruit strongly transversely rugose.

Wet ground, ditches, often floating in margins of lakes. Tropical regions of both hemispheres.

CANAL ZONE: Balboa, *Standley 25631, 30877;* Gatún, *Hitchcock 7980; Killip 4292;* between Corozal and Ancón, *Pittier 2168, 2170;* Pedro Miguel, *Hitchcock 7956;* Empire, *Pittier 3714;* Barro Colorado Island, *Kenoyer 124.*

6. PANICUM PURPURASCENS Raddi, Agrost. Bras. 47. 1823.

Panicum barbinode Trin. Mém. Acad. St. Pétersb. VI. Sci. Nat. 1:256. 1834.
Panicum guadaloupense Steud. Syn. Pl. Glum. 1:61. 1854.
Panicum equinum Salzm. ex Steud. Syn. Pl. Glum. 1:67. 1854.
Panicum pictigluma Steud. Syn. Pl. Glum. 1:73. 1854.
Panicum paraguayense Steud. ex Doell in Mart. Fl. Bras. 2^2:189. 1877.

Fig. 22
Panicum purpurascens

Stoloniferous perennial; culms as much as 6 m. long, coarse, decumbent at the base and rooting at the lower nodes, often geniculate, the nodes densely villous; sheaths mostly longer than the internodes, papillose or papillose-pilose, densely pubescent on the collar; ligule ciliate, 0.5–1 mm. long; blades 10–25 cm. long, 8–15 mm. wide, acuminate, the margins strongly scabrous; panicles 10–20 cm. long with several solitary or fascicled spreading racemes; spikelets 3 mm. long, glabrous, pointed, the first glume 1 mm. long, acute, the pedicels bearing a few long stiff hairs below the spikelets; fruit about 2.5 mm. long, obtuse, minutely transversely rugose.

Cultivated and waste ground, escaped from cultivation, throughout tropical and subtropical America. Commonly cultivated for forage.

CHIRIQUÍ: El Boquete, *Hitchcock 8266.* CANAL ZONE: Gatún, *Pittier 2559; Hitchcock 8031½;* Frijoles, *Standley 27654; Killip 4301;* Darién, *Standley 31582;* Culebra, *Hitchcock 7931; Standley 26032; Pittier 4807.* PANAMÁ: Chagres River, *Piper 5256;* Chepo, *Pittier 4734.*

7. PANICUM FASCICULATUM Swartz, Prodr. Veg. Ind. Occ. 22. 1788.

Panicum chartaginense Swartz, Prodr. Veg. Ind. Occ. 22. 1788.
Panicum fuscum Swartz, Prodr. Veg. Ind. Occ. 23. 1788.
Panicum flavescens Swartz, Prodr. Veg. Ind. Occ. 23. 1788.
Panicum fusco-rubens Lam. Tabl. Encycl. 1:171. 1791.
Panicum fastigiatum Poir. in Lam. Encycl. Suppl. 4:277. 1816.
Panicum spithamaeum Willd. ex Nees, Agrost. Bras. 152. 1829.
Panicum illinoniense Desv. Opusc. 91. 1831.
Panicum reticulatum Griseb. Abh. Ges. Wiss. Gött. 7:264. 1857. Not *P. reticulatum* Torr. 1852.
Panicum fuscum fasciculatum Griseb. Fl. Brit. W. Ind. 547. 1864.
Panicum fasciculatum genuinum Doell in Mart. Fl. Bras. 2^2:204. 1877.
Panicum fasciculatum flavescens Doell in Mart. Fl. Bras. 2^2:205. 1877.
Panicum fasciculatum fuscum Doell in Mart. Fl. Bras. 2^2:205. 1877.
Panicum fasciculatum chartaginense Doell in Mart. Fl. Bras. 2^2:205. 1877.

Annual; culms slender, branching, erect or decumbent at the base, glabrous or papillose-hispid, 15 cm. to as much as 1 m. long; sheaths papillose or papillose-hispid, especially on the margins; blades 5–25 cm. long, 0.5–2 cm. wide, glabrous or scaberulous, the margins scabrous; panicles 3–15 cm. long, rather dense, the branches ascending to spreading; spikelets 2.5–3 mm. long, dark brown, often tinged with purple, glabrous, the second glume and sterile lemma prominently reticulate-veined; fruit pale, strongly transversely rugose, acute.

Open woods, thickets, a weed in fields and waste places, Florida, Texas, and the West Indies to Ecuador and Brazil.

BOCAS DEL TORO: Laguna de Chiriquí, *von Wedel 1216, 1448, 2504.* CHIRIQUÍ: David, *Hitchcock 8350.* COLÓN: Porto Bello, *Pittier 2478.* SAN BLAS: Puerto Obaldía, *Pittier 4375.* CANAL ZONE: Balboa, *Standley 25236, 25247;* Culebra, *Hitchcock 7908, 7932;* Empire, *Pittier 3718;* Las Cruces Trail, *Standley 29115.* PANAMÁ: Matías Hernández, *Pittier 4719, 6902, 6921;* Panamá, *Bartlett & Lasser 16329, 16330;* Chepo, *Pittier 4695;* Taboga Island, *Killip 4148, Hitchcock 8076, 8079; Woodson, Allen & Seibert 1526; Standley 27027, 27909.* DARIÉN: Boca de Cupe, *Allen 898.*

8. PANICUM MOLLE Swartz, Prodr. Veg. Ind. Occ. 22. 1788.

Annual; culms 15–75 cm. long, erect or ascending, often geniculate and rooting at the lower nodes, finely pubescent or pilose, especially below the densely pubescent nodes; sheaths softly pubescent, usually shorter but often longer than the internodes; ligule ciliate, about 1 mm. long; blades 5–25 cm. long, 6–20 mm. wide, or sometimes those of the branches smaller, softly pubescent on both surfaces, the white firm margins scabrous; panicles 5–12 cm. long, the main axis and rachises of narrowly ascending racemes densely pubescent; spikelets 3.5–4 mm. long, rather dense, usually brown or tinged with purple, abruptly pointed, densely pubescent, the first glume broad, acute, half to three-fourths as long as the spikelets; fruit 2.5–3 mm. long, acute or apiculate, finely transversely rugose.

Dry or moist ground in fields and waste places, sometimes in brush and open woods, central Mexico to Argentina.

CANAL ZONE: Madden Dam, *Bartlett & Lasser 76803.* PANAMÁ: Taboga Island, *Hitchcock 8067;* Chamé Point, *Hitchcock 8168.*

9. PANICUM CHLOROTICUM Nees ex Trin. Gram. Pan. 236. 1826.

Annual; culms prostrate or ascending, 30–60 cm. or sometimes more than 1 m. long, branching, rather succulent; sheaths somewhat inflated, glabrous; ligule ciliate, 2–3 mm. long; blades flat, abruptly acute, 5–20 cm. long, 4–10 mm. wide, the margins scabrous; panicles 5–20 cm. long, the branches rather stiffly ascending or spreading, naked toward the base; spikelets appressed, 2.5 mm. long, lanceolate, glabrous, the first glume about one fourth as long as the spikelet.

Wet open ground, Mexico (Sinaloa) to Argentina.

CANAL ZONE: Gatún, *Hitchcock 7977*. PANAMÁ: Chepo, *Pittier 4614;* La Jagua, *Bartlett & Lasser 16990*.

10. PANICUM HIRTICAULE Presl, Rel. Haenk. 1:308. 1830.

Panicum flabellatum Fourn. Bull. Soc. Bot. France II. 27:293. 1880.
Panicum polygonatum var. *β. hirticaule* Fourn. Mex. Pl. 2:28. 1886.

Annual; culms 15–70 cm. high in small erect tufts, sparingly branched, papillose-hispid, especially below the nodes; sheaths usually a little shorter than the internodes, conspicuously papillose-hispid with spreading hairs; ligule ciliate, about 1 mm. long; blades 8–25 cm. long, 4–10 mm. wide, lanceolate, subcordate, sparsely to rather densely papillose-hispid, the margins scabrous and often papillose-hispid-ciliate; panicles 5–15 cm. long, usually brown, the rather slender ascending branches naked in the lower half; spikelets 2.5–3.3 mm. long, acuminate or abruptly pointed, the first glume acute, half to two-thirds as long as the spikelet; fruit 1.8–2 mm. long, smooth and shining.

Fields, brushy slopes, and waste ground, southwestern United States to Bolivia.

CANAL ZONE: Balboa, *Standley 25277, 27407*. PANAMÁ: Taboga Island, *Standley 27960*.

11. PANICUM CAYENNENSE Lam. Tabl. Encycl. 1:173. 1791.

Panicum pedunculare Willd. ex Steud. Syn. Pl. Glum. 1:77. 1854.
Panicum cayennense var. *α. patulum* Doell in Mart. Fl. Bras. 2^2:220. 1877.

Annual; culms 20–75 cm. high, usually erect, simple or sometimes much branched at the base; sheaths densely papillose-hispid, the hairs ascending or spreading; ligule ciliate, 1–1.5 mm. long; blades 12–20 cm. long, 5–8 mm. wide (smaller in depauperate specimens), linear-lanceolate, sparsely to rather densely papillose-pilose, the margins very scabrous; panicles terminal and axillary, 8–20 cm. long, the branches and branchlets divergent, becoming implicate, few-flowered; spikelets about 2.2 mm. long, obovoid, strongly nerved, the first glume acute, half as long as the spikelet; fruit 1.7 mm. long.

Fields, thickets, open ground, and roadsides, often weedy, Mexico (Chiapas) and the Greater Antilles to Brazil.

CHIRIQUÍ: Dolega, *Hitchcock 8335;* David, *Hitchcock 8372*. PANAMÁ: Arraiján, *Woodson, Allen & Seibert 1402*.

12. PANICUM HIRSUTUM Swartz, Fl. Ind. Occ. 1:173. 1797.

Perennial; culms robust, erect, 1.5 m. or more high, the nodes densely appressed-pubescent; sheaths papillose or papillose-pilose, somewhat inflated; ligule 4–5 mm.

long, densely ciliate; blades 30–60 cm. long, 1.5–4 cm. wide, glabrous or nearly so on both surfaces, the margins scabrous-serrate; panicles as much as 45 cm. long, the branches narrowly ascending or somewhat spreading, densely flowered, naked toward the base; spikelets 2 mm. long, acute, glabrous, the first glume acute or subobtuse, about half as long as the spikelet.

Old fields, brushy slopes, forests and swamps, Yucatan, the West Indies, Honduras, and Panama.

BOCAS DEL TORO: Changuinola Valley, *Dunlap 37a.* SAN BLAS: Puerto Obaldía, *Pittier 4374.* CANAL ZONE: Gamboa, *Standley 28444;* Gorgona, *Hitchcock 7964;* Culebra, *Pittier 3441;* Bohio, *Hitchcock 8392, 8397.* PANAMÁ: Matías Hernández, *Pittier 6943.*

13. PANICUM GHIESBREGHTII Fourn. Mex. Pl. 2:29. 1886.

Panicum hirtivaginum Hitchc. Contr. U. S. Nat. Herb. 12:223. 1909.

Perennial; culms 25–80 cm. high, erect, in small tufts, rather coarse, papillose-hispid with ascending or spreading hairs; sheaths papillose-hispid, mostly longer than the internodes; ligule membranaceous, ciliate, about 1 mm. long; blades mostly 15–30 cm. long, rarely as much as 60 cm., 4–10 mm. wide, rather thin, sparsely to densely papillose-hispid; panicles 15–30 cm. long, the branches stiffly ascending, naked in the lower half; spikelets 3 mm. long, lanceolate, glabrous, the first glume acute, about half as long as the spikelet; fruit 2 mm. long.

Fields, roadsides, and thickets, usually in low moist ground, Mexico and the West Indies to Brazil and Bolivia.

CHIRIQUÍ: David, *Hitchcock 8377.* CANAL ZONE: Ancón, *Killip 4100;* Balboa, *Hitchcock 7997, 8014.* PANAMÁ: Chepo, *Hunter & Allen 63;* Taboga Island, *Hitchcock 8065, 8094.*

14. PANICUM **rigidum** Swallen, sp. nov.

Perenne; culmi 15–20 cm. alti, erecti vel geniculati; vaginae approximatae internodiis multo longiores, carinatae, glabrae; ligula ca. 1 mm. longa; laminae 8–10 cm. longae, 5–10 mm. latae, acuminatae, supra papilloso-pilosae vel villosae; paniculae 5–8 cm. longae, ramis et ramulis adscendentes vel patentes, basi nudis; spiculae 3.5–4 mm. longae, appressae, glabrae; gluma prima 1.5 mm. longa, acuta; gluma secunda et lemma sterile aequalia, acuta, fructu longiora; fructus 3 mm. longus, 1.1 mm. latus, abrupte acutus.

Perennial; culms 15–20 cm. high, simple or branched from the lower nodes, stiffly erect or geniculate-spreading at the nodes; sheaths crowded, much longer than the short internodes, keeled, glabrous; ligule membranaceous, ciliate, about 1 mm. long including the cilia; blades 8–10 cm. long, 5–10 mm. wide, acuminate, rounded and clasping at the base, the margins and lower surface glabrous, the upper surface sparsely to densely papillose-pilose or villous; panicles 5–8 cm. long, short-exserted or partly enclosed in the sheath, the branches and branchlets stiffly ascending or spreading, naked at the base; spikelets 3.5 mm. long, appressed, glabrous; first glume 1.5 mm. long, broad, clasping, triangular, acute; second glume and sterile lemma equal, acute, pointed beyond the fruit; fruit 3 mm. long, 1.1 mm. wide, abruptly acute or pointed, with a few short hairs at the tip.

Savannas, Panama.

PANAMÁ: Sabana de Juan Corso, near Chepo, alt. 60–80 m., *Pittier 4526* (U. S. Nat. Herb., TYPE).

15. PANICUM RUDGEI Roem. & Schult. Syst. Veg. 2:444. 1817.

Panicum scoparium Rudge, Pl. Guian. 1:21. 1805. Not *P. scoparium* Lam., 1798.
Panicum rudgei β. brasiliense Raddi, Agrost. Bras. 48. 1823.
Panicum dasytrichum Spreng. Syst. Veg. 1:317. 1825.
Panicum rhigiophyllum Steud. Syn. Pl. Glum. 1:76. 1854.
Panicum cayennense var. *divaricatum* Doell in Mart. Fl. Bras. 2^2:220. 1877.

Perennial; culms 40–110 cm. high, suberect to spreading, rather coarse, appressed papillose-hispid especially below the nodes; sheaths longer or shorter than the internodes, densely papillose-hispid with appressed or spreading hairs; ligule ciliate, about 1 mm. long; blades 15–40 cm. long, 5–10 mm. wide, thick and firm, ascending, gradually acuminate, densely hirsute to nearly glabrous; panicles terminal and axillary from the upper sheaths, included at the base, overlapping, the branches spreading, implicate, pilose in the axils; spikelets 3.5 mm. long, pointed, somewhat attenuate at the base, sparsely hirsute, the first glume acuminate, two-thirds as long as the spikelet; fruit 2.1 mm. long, smooth and shining.

Dry open ground and brushy slopes, Guatemala and Jamaica to Brazil and Colombia.

CANAL ZONE: Fort Randolph, *Standley 28598*. PANAMÁ: Taboga, *Killip 4163*.

16. PANICUM PULCHELLUM Raddi, Agrost. Bras. 42. 1823.

Eriochloa? pulchella Kunth, Rév. Gram. 1:30. 1829.
Panicum leptostachyum Presl, Rel. Haenk. 1:311. 1830.
Panicum bipustulatum Schlecht. Linnaea 26:135. 1853.
Hymenachne leptostachya Fourn. Mex. Pl. 2:36. 1886.

Perennial though often appearing like an annual; culms 15–75 cm. long, slender, rather delicate, decumbent at the base and rooting at the lower nodes, the branches ascending or erect, the nodes pubescent; sheaths much shorter than the internodes, more or less pilose, the margins ciliate; blades thin, ovate-lanceolate, asymmetrical, subcordate, 1.5–5 cm. long, 8–18 mm. wide, pilose or nearly glabrous; panicles 3–14 cm. long, the racemes 5–15 mm. long, rather stiffly spreading or reflexed, rather distant or approximate; spikelets 2 mm. long, turgid, pilose, the hairs longer near the margins; first glume acute, about one-third the length of the spikelet, the sterile lemma with two conspicuous crateriform glands; fruit 1.3 mm. long.

Shady banks, moist thickets, and forests, southern Mexico and the Windward Islands to Brazil.

CHIRIQUÍ: Cerro Vaca, *Pittier 5375*. COLÓN: Catival, *Standley 30176*. CANAL ZONE: Fort Sherman, *Standley 31045*; Culebra, *Pittier 2226*; Obispo, *Standley 31751*; Summit, *Standley 29628*; Corozal, *Hitchcock 9200*; Quebrada Bonita, *Steyermark & Allen 17157*. PANAMÁ: Río Tecúmen, *Standley 26554*; Chepo, *Hunter & Allen 54*.

17. PANICUM STOLONIFERUM Poir. in Lam. Encycl. Suppl. 4:274. 1816.

Panicum ctenodes Trin. Gram. Icon. 2: *pl. 171*. 1829.
Panicum leprieurii Steud. Syn. Pl. Glum. 1:65. 1854.

Perennial; culms very slender, decumbent-spreading, branching, rooting at the lower nodes, 10–50 cm. long, the nodes pubescent or glabrous; sheaths usually much shorter than the internodes, ciliate; blades 1–5 cm. long (rarely to 7 cm.), 3–15 mm. wide, glabrous or minutely pubescent; panicles 1–5 cm. long, with few to several abruptly spreading racemes 5–10 mm. long; spikelets 2.5 mm. long, the first glume acute, one-third to half as long as the spikelet; fruit 1.3 mm. long.

Moist woods, swamps, and low ground, Guatemala to Ecuador and Brazil.

BOCAS DEL TORO: Isla Colón, *von Wedel 1254.* CANAL ZONE: Frijoles, *Hitchcock 8399.* PANAMÁ: Río Tecúmen, *Standley 26682.*

18. PANICUM FRONDESCENS G. Meyer, Prim. Fl. Esseq. 56. 1818.

Panicum olyraefolium Raddi, Agrost. Bras. 43. *pl. 1. f. 6.* 1823.
Panicum ctenodes var. *majus* Trin. Gram. Icon. 2: *pl. 171. f. A.* 1829.
Panicum stoloniferum var. *majus* Kunth, Rév. Gram. 2:389. 1831.
Panicum kegelii Steud. Syn. Pl. Glum. 1:65. 1854.
Hymenachne frondescens Fourn. Mex. Pl. 2:36. 1886.

Perennial; culms slender, ascending from a decumbent base, rooting at the nodes, branching, sparsely pilose, 15–60 cm. long; sheaths much shorter than the internodes, ciliate, more or less pilose in the throat, pubescent across the back on the collar; blades lanceolate, acuminate, mostly 5–11 cm. long, 8–15 mm. wide, narrowed at the more or less petiolate base, glabrous or minutely pubescent, the margins scabrous; panicles 4–11 cm. long, the usually numerous, crowded, densely flowered racemes 5–25 mm. long, finally spreading or even reflexed; spikelets about 2.7 mm. long, crowded, spreading, glabrous, the first glume acute, about one-third as long as the spikelet; fruit 1.5–1.6 mm. long, short-stipitate.

Shady river banks, swamps, and moist open ground, Mexico to Brazil.

BOCAS DEL TORO: *Carleton 38;* Pumpkin River, *von Wedel 2575.* CHIRIQUÍ: Puerto Armuelles, *Woodson & Schery 858.* COLÓN: Río Sirrí, *Pittier 4027.* SAN BLAS: Permé, *G. Proctor Cooper III 288.* CANAL ZONE: Margarita Swamp, *Maxon & Valentine 7069;* Frijoles, *Killip 4354.*

19. PANICUM MILLEFLORUM Hitchc. & Chase, Contr. U. S. Nat. Herb. 17:494. *f. 70.* 1915.

Perennial; culms erect or sometimes geniculate, as much as 2 m. high, glabrous, the nodes pubescent; sheaths shorter than the internodes, sparsely to rather densely papillose-pilose, densely pubescent on the collar; ligule obsolete or nearly so; blades acuminate, 15–35 cm. long, 12–20 mm. wide, sparsely pilose, the margins scabrous; panicles 25–45 cm. long, the densely flowered branches papillose-pilose, the lower ones in rather distant fascicles, ascending with numerous short branchlets, the upper ones simple, spreading; spikelets 1.3 mm. long.

Swampy places, British Honduras; Panama to Brazil.

CANAL ZONE: between Mindi and Colón, *Hitchcock 7942;* Frijoles, *Hitchcock 8387* (TYPE); Juan Mina, *Bartlett & Lasser 16886.*

20. PANICUM PILOSUM Swartz, Prodr. Veg. Ind. Occ. 22. 1788.

Panicum distichum Lam. Encycl. 4:731. 1798.
Panicum pilisparsum G. Meyer, Prim. Fl. Esseq. 57. 1818.

Panicum trichophorum Schrad. ex Schult. Mant. 2:247. 1824.
Setaria disticha Humb. ex Spreng. Syst. Veg. 1:305. 1825.
Panicum densiflorum Willd. ex Spreng. Syst. Veg. 1:320. 1825.
Setaria pilosa Kunth, Rév. Gram. 1:47. 1829.
Setaria meyeri Kunth, Rév. Gram. 1:47. 1829.
Setaria schraderi Kunth, Rév. Gram. 1:47. 1829.

Perennial; culms erect or decumbent at the base and rooting at the lower nodes, 25–60 cm. or sometimes as much as 1 m. long, branching, the nodes glabrous; sheaths longer than the internodes, the margins papillose-ciliate at least toward the summit; ligule wanting; blades 5–20 cm. long, 6–10 mm. wide (rarely as much as 15 mm.), widest at the cordate base, glabrous on the lower surface, sparsely hispid on the upper, the margins scabrous; panicles erect, 5–15 cm. long, the branches simple, 1–4 cm. long, usually stiffly and abruptly spreading, the rachis papillose-hispid, the hairs sometimes sparse; spikelets 1.3–1.5 mm. long, crowded.

Swamps, wet ground and open woods, Mexico and the West Indies to Brazil.

CHIRIQUÍ: David, *Hitchcock 8347*. COLÓN: Catival, *Standley 30313*; Porto Bello, *Pittier 2481*. SAN BLAS: Puerto Obaldía, *Pittier 4371*. CANAL ZONE: Gatún, *Hitchcock 8029*; Frijoles, *Hitchcock 8396*; *Piper 5222*; *Standley 27535*; *Killip 1213*; Barro Colorado Island, *Standley 40830*; Ancón Hill, *Seibert 373*; Balboa, *Hitchcock 8061*. PANAMÁ: Chorrera, *Hitchcock 8139*; Quebrada La Palma and Cañon of Río Chagres, *Dodge & Allen 17350*; Chepo, *Hunter & Allen 14*; Taboga Island, *Standley 27895*; *Hitchcock 8083*.

21. PANICUM POLYGONATUM Schrad. ex Schult. Mant. 2:256. 1824.

Panicum potamium Trin. Gram. Pan. 239. 1826.
Setaria polygonata Kunth, Rév. Gram. 1:47. 1829.
Panicum pilosum var. *polygonatum* Doell in Mart. Fl. Bras. 2^2:211. 1877.
Panicum bourgaei Fourn. Mex. Pl. 2:25. 1886.

Perennial; culms slender, widely decumbent-spreading, branching, the nodes pubescent, rooting at the lower nodes, the internodes usually rather short; sheaths shorter than the internodes, glabrous, the margins ciliate; ligule about 0.3 mm. long, membranaceous, erose; blades rather thin, cordate, mostly 5–8 cm. long, 5–10 mm. (rarely 15 mm.) wide, glabrous or sparsely pilose; panicles 6–15 cm. long, the usually numerous branches ascending, the branchlets appressed or spreading, mostly on the lower side of the branches; spikelets 1.5 mm. long, glabrous.

Swamps, ditches, muddy river banks, and wet thickets, southern Mexico (Chiapas) to Paraguay.

BOCAS DEL TORO: Laguna de Chiriquí, *Hart 73*; *von Wedel 1121*; Bocas del Toro, *Carleton 69a*. COLÓN: Catival, *Standley 3021*. SAN BLAS: Permé, *G. Proctor Cooper III 268*. CANAL ZONE: Mindi and Colón, *Hitchcock 7943*; Gatún, *Hitchcock 9172*; between Bohio and Frijoles, *Hitchcock 8395*; Juan Mina, *Bartlett & Lasser 16770*; between Gorgona and Tabernilla, *Hitchcock 7965*; Gamboa, *Heriberto 66*. PANAMÁ: Pinogana, *Pittier 6576*; Río Tecúmen, *Killip 4316*.

22. PANICUM LAXUM Swartz, Prodr. Veg. Ind. Occ. 23. 1788.

Panicum agrostidiforme Lam. Tabl. Encycl. 1:172. 1791.
Panicum tenuiculme G. Meyer, Prim. Fl. Esseq. 58. 1818.
Panicum leptomerum Presl, Rel. Haenk. 1:311. 1830.
Panicum diandrum Kunth, Rév. Gram. 2:393. 1831.

Panicum ramuliflorum Hochst. ex Steud. Syn. Pl. Glum. 1:65. 1854.
Agrostis nigrescens Salzm. ex Steud. Syn. Pl. Glum. 1:65. 1854.
Panicum pilosum var. β. *epilosum* Fourn. Mex. Pl. 2:24. 1886.

Perennial; culms geniculate-ascending or decumbent at the base and rooting at the nodes, 15–100 cm. long, branching, glabrous; sheaths mostly shorter than the internodes, nearly glabrous to papillose or papillose-hispid, especially near the summit, with a dense pubescent line on the collar, the margins usually densely ciliate; blades mostly 5–12 cm. long, sometimes longer, 5–10 mm., or rarely to 15 mm., wide, rounded or subcordate at the base, the lower surface nearly smooth, the upper scaberulous, sometimes sparsely pilose, the margins usually scabrous; panicle 5–30 cm. long, composed of several to many slender raceme-like branches, the lower ones rather distant, spreading, the upper ascending, successively shorter; branchlets secund on the lower side of the branches, densely flowered; spikelets 1–1.5 mm. long, the first glume about half as long.

Forests, river banks, along ditches, and moist places, Mexico and the West Indies to Paraguay.

BOCAS DEL TORO: Laguna de Chiriquí, *Hart 86;* Bocas del Toro, *Carleton 69.* CHIRIQUÍ: David, *Hitchcock 8346, 8350;* Dolega, *Hitchcock 8334.* COCLÉ: Olá, *Pittier s. n.* COLÓN: Porto Bello, *Pittier 2443.* CANAL ZONE: Fort Randolph, *Standley 28534;* Gatún, *Hitchcock 7968, 8027;* Darién Station, *Standley 31510;* Gamboa, *Pittier 4789;* Empire to Mandinga, *Piper 5251;* Culebra, *Hitchcock 7900; Standley 25995;* between Fort Clayton and Corozal, *Standley 29098;* between Pedro Miguel and Corozal, *Hitchcock 7993;* Ancón, *Killip 4113.* PANAMÁ: Quebrada La Palma and Cañon of Río Chagres, *Dodge & Allen 17351;* Chorrera, *Hitchcock 8134;* Chepo, *Pittier 4615;* between Pacora and Chepo, *Woodson, Allen & Seibert 1632;* Río Tecúmen, *Standley 26663.* DARIÉN: Sambú River, *Pittier 5234.*

23. PANICUM BOLIVIENSE Hack. Repert. Sp. Nov. (Fedde) 11:19. 1912.

Perennial; culms as much as 1.5 m. long, decumbent-spreading, rooting at the lower nodes, the nodes glabrous (rarely minutely pubescent); ligule a ciliate membrane, about 0.5 mm. long; sheaths glabrous or papillose-hispid toward the summit, the margins ciliate or nearly glabrous; blades 5–15 cm. long (rarely to 20 cm.), 7–20 mm. wide, acuminate, cordate at the base, glabrous on both surfaces, the margins very scabrous; panicles 10–25 cm. long, loosely flowered, the branchlets spreading, usually secund on the lower side of the ascending branches; spikelets 1.5–1.6 mm. long, glabrous, the first glume acute, about half the length of the spikelet; fruit 1.4 mm. long, subacute.

Ditches, marshy stream banks, and wet open ground or open woods, Mexico (Veracruz) and Cuba to Paraguay.

BOCAS DEL TORO: Changuinola Valley, *Dunlap 184.* COCLÉ: El Valle de Antón, *Seibert 485; Martin 3032.* PANAMÁ: Panamá, *Hitchcock 8400;* La Jagua, *Bartlett & Lasser 16988.*

24. PANICUM STAGNATILE Hitchc. & Chase, Contr. U. S. Nat. Herb. 17:528. 1915.

Panicum bernoullianum Mez, Bot. Jahrb. (Engler) 56: Beibl. 125:3. 1921.

Perennial; culms erect from a decumbent base, rooting at the lower nodes,

simple or sparingly branched, 1–2 m. long, the nodes glabrous or sparsely pubescent; lower sheaths usually much shorter than the internodes, the upper ones sometimes overlapping, the margins ciliate, more or less hispid at the throat; ligule membranaceous, less than 1 mm. long; blades 20–25 cm. long, 1.5–3 cm. wide, acuminate, gradually narrowed from below the middle, rounded at the base, glabrous on both surfaces, the margins scabrous; panicles 20–40 cm. long, finally exserted, the branches approximate, stiffly ascending, the lower ones 8–12 cm. long, the branches stiffly divergent; spikelets 1.8 mm. long, short-pedicellate, acute, glabrous; first glume acute, one-third to half as long as the spikelet, the second shorter than the fruit; fruit 1.6 mm. long, acute, the margins inrolled only at the base.

Fig. 23
Panicum stagnatile

Swamps, growing in water, Mexico (Tabasco) to Panama.

BOCAS DEL TORO: Isla Colón, *von Wedel 1288;* Little Bocas, *von Wedel 2486.* CANAL ZONE: Frijoles, *Hitchcock 8388* (TYPE).

25. PANICUM PYRULARIUM Hitchc. & Chase, Contr. U. S. Nat. Herb. 17:508. 1915.

Fig. 24
Panicum pyrularium

Annual; culms delicate, 10–30 cm. long, finally decumbent and branching, often rooting at the nodes, more or less zigzag, the nodes glabrous or sparsely pilose; blades 1–3 cm. long, 2–7 mm. wide, rather thin, clasping at the base, subacute, glabrous or sparsely pilose, the margins scabrous; panicles 2–5 cm. long, oval or pyramidal, the delicate flexuous branches spreading or reflexed; spikelets 1.5 mm. long, turgid, pyriform, attenuate at the base, glabrous, the first glume acute, about half as long as the spikelet; fruit 1 mm. long, turgid.

CHIRIQUÍ: between Hato del Jobo and Cerro Vaca, *Pittier 5416* (TYPE). Known only from the type collection.

26. PANICUM HAENKEANUM Presl, Rel. Haenk. 1:304. 1830.
Panicum costaricense Hack. Oesterr. Bot. Zeitschr. 51:428. 1901.

Perennial; culms relatively slender, straggling, sparingly to rather freely branching, sometimes rooting at the lower nodes, mostly about 1 m. long, pilose at least below the nodes; sheaths usually much shorter than the internodes, papillose-hispid especially toward the summit, densely pubescent on the collar; blades 5–10 cm. long, 6–12 mm. wide, acuminate, somewhat narrowed toward the more or less rounded base, pilose on the lower surface especially along the midnerve, papillose-hispid on the upper surface; panicles 10–15 cm. long, oblong, the slender flexuous spreading branches in rather distant fascicles; spikelets 2.3–2.5 mm. long on long or rather short capillary flexuous pedicels, sparsely pilose on the margins of the glumes and sterile lemma, the first glume about half as long as the spikelet; fruit 1.7 mm. long, smooth and shining.

Open woods and usually moist grassy banks, southern Mexico to Venezuela.

CHIRIQUÍ: San Felix, *Pittier 5247.* CANAL ZONE: Culebra, *Hitchcock 9168;* Pedro Miguel, *Killip 4309;* Ancón Hill, *Piper 5266; Killip 4183;* between Corozal and Ancón, *Pittier 2169, 2636;* between Panamá and Corozal, *Hitchcock 9206.* PANAMÁ: Pacora, *Killip 4237;* Aguarubia, *Killip 4282;* Campana, *Allen 1317.*

27. PANICUM TRICHOIDES Swartz, Prodr. Veg. Ind. Occ. 24. 1788.

Panicum capillaceum Lam. Tabl. Encycl. 1:173. 1791.
Panicum capillaceum var. *β. strictius* Doell in Mart. Fl. Bras. 2^2:249. 1877.

Annual; culms slender, freely branching, decumbent-spreading or creeping, 15–60 cm. long, the branches ascending; sheaths shorter than the internodes or the upper ones overlapping, papillose-hispid with spreading hairs; blades 4–7 cm. long, 8–15 mm. wide, ovate or ovate-lanceolate, thin, more or less pilose, the margins ciliate toward the base; panicles 5–20 cm. long, more or less included in the upper sheath, the slender branches ascending or spreading, the branchlets and pedicels of the spikelets capillary, divergent; spikelets 1.5 mm. long, sparsely pilose or nearly glabrous, the fruit exposed at the summit, the first glume about half as long as the spikelet.

Woods, open ground and waste places, especially along trails, Mexico and the West Indies to Peru and Brazil.

BOCAS DEL TORO: Lincoln Creek, *Carleton 130, 191;* Water Valley, *von Wedel 2661.* CHIRIQUÍ: Puerto Armuelles, *Woodson & Schery 865.* SAN BLAS: Permé, *G. Proctor Cooper III 269.* COLÓN: Cativa1, *Standley 30255.* CANAL ZONE: Río Pequení, *Woodson, Allen & Seibert 1621;* Frijoles, *Piper 5244; Killip 12127;* Culebra, *Pittier 2083; Hitchcock 7933;* Ancón Hill, *Killip 4207;* Las Cruces Trail, *Hunter & Allen 727.* PANAMÁ: Matías Hernández, *Pittier 6761, 6854;* Panamá, *Killip 4190;* Chepo, *Pittier 4696;* Taboga Island, *Standley 27028; Killip 4139.* DARIÉN: Boca de Cupe, *Allen 878.*

28. PANICUM TRICHANTHUM Nees, Agrost. Bras. 210. 1829.

Panicum guayaquilense Steud. Syn. Pl. Glum. 1:85. 1854.

Perennial; culms straggling or clambering, geniculate, branching, rooting at the nodes, mostly 1–2 m. long; sheaths shorter than the internodes, glabrous, often ciliate on the margins; blades 8–15 cm. long, 1–2 cm. wide, lanceolate, acuminate, often asymmetrical, rounded or subcordate at the base, sparsely pilose, more or less ciliate, at least near the base; panicles mostly 20–30 cm. long, diffuse, the branches rather stiffly spreading or even reflexed at maturity, the branchlets becoming implicate; spikelets 1.2–1.5 mm. long on long slender spreading pedicels, glabrous, the first glume about one-fifth as long as the spikelet.

River banks, lake shores, moist thickets and swampy places, Mexico and the West Indies to Paraguay.

BOCAS DEL TORO: Isla Colón, *von Wedel 1306;* Old Bank Island, *von Wedel 1998;* Water Valley, *von Wedel 1449.* CANAL ZONE: Frijoles, *Maxon 4703; Standley 31477; Killip 4288; Piper 5242;* Tabernilla, *Pittier 3824; Hitchcock 8383;* Culebra, *Hitchcock 7895;* Balboa, *Hitchcock 8015.* PANAMÁ: Matías Hernández, *Pittier 6945;* Abalaba, *Killip 4283;* Río Tecúmen, *Standley 26679;* Río Tapia, *Standley 26154.*

29. PANICUM SELLOWII Nees, Agrost. Bras. 153. 1829.

Panicum lasianthum Trin. Gram. Icon. 3: *pl. 245.* 1830.

Panicum puberulum Trin. Mém. Acad. St. Petersb. VI. Sci. Nat. 1:277. 1834.
Panicum valenzuelanum A. Rich. in Sagra, Hist. Cuba 11:304. 1850.
Panicum rugulosum var. *hirtiglume* Griseb. Cat. Pl. Cub. 233. 1866.

Perennial; culms 60 cm. to more than 1 m. long, branching, straggling, rooting at the lower nodes; sheaths glabrous or papillose-pilose, the margins ciliate at least toward the summit, the collar densely pubescent; blades 4–15 cm. long, 10–30 mm. wide, ovate-lanceolate, acuminate, usually asymmetrical, sparsely pilose or

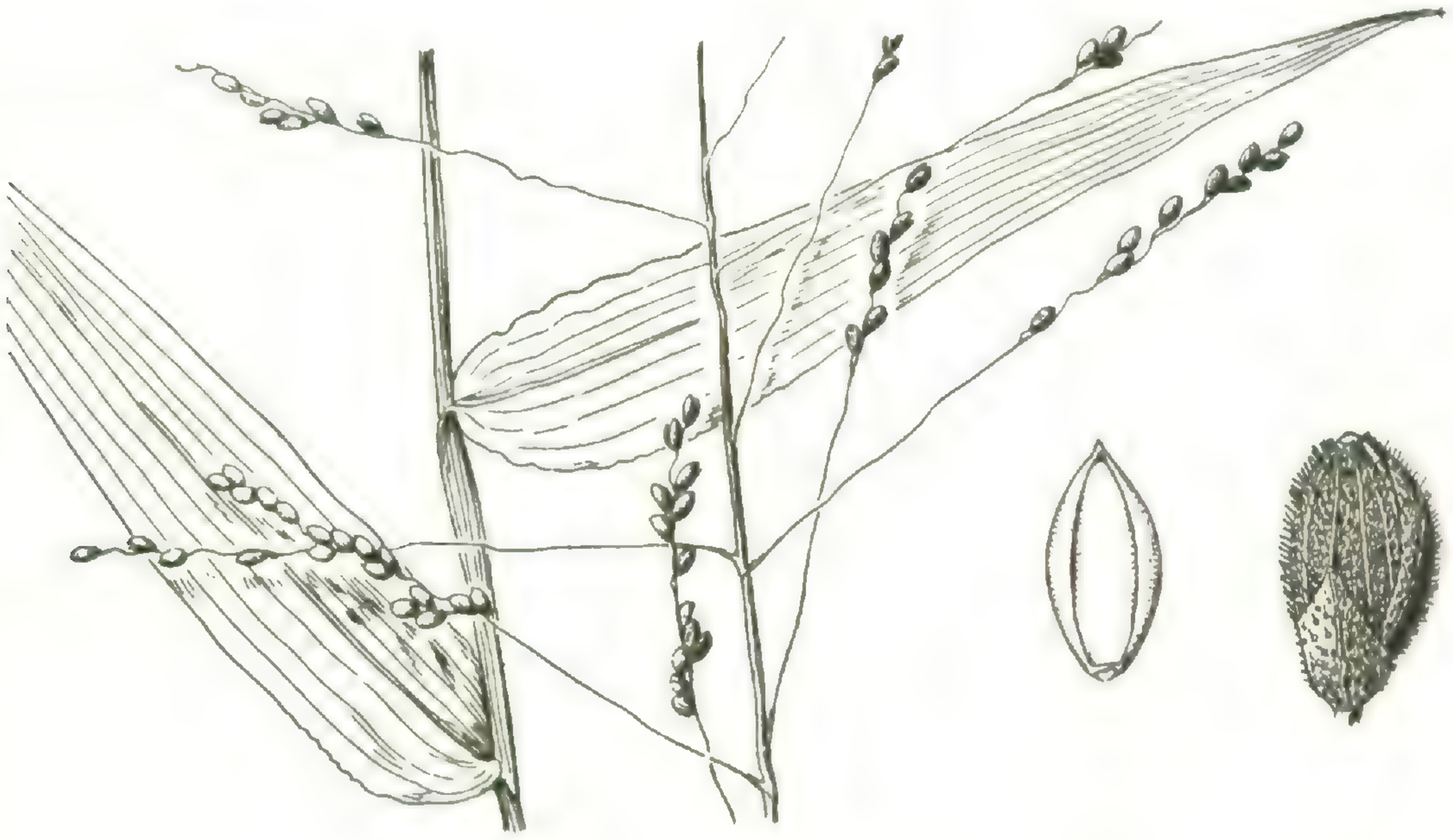

Fig. 25. *Panicum sellowii*

more or less softly pubescent, the margins very scabrous; panicles 10–20 cm. long, the branches ascending or spreading, naked in the lower half or two-thirds, densely pilose in the axils; spikelets short-pedicellate, appressed to the branchlets, appearing more or less clustered, 2 mm. long, obovate, obtuse, glabrous or sparsely papillose-hispid, the first glume rather narrow, acute or subobtuse, half to three-fourths as long as the spikelet.

Moist banks, woods, and brushy slopes, southern Mexico and the West Indies to Paraguay.

CHIRIQUÍ: El Boquete, *Hitchcock 8299.*

30. PANICUM ARUNDINARIAE Trin. ex Fourn. Mex. Pl. 2:25. 1886.
Panicum virgultorum Hack. Oesterr. Bot. Zeitschr. 51:369. 1901.

Fig. 26
Panicum arundinariae

Perennial; culms clambering or straggling, 0.5–1.5 m. long, freely branching, glabrous or very sparsely pubescent; sheaths shorter than the internodes, glabrous, densely pubescent on the collar; blades lanceolate, 4–15 cm. long, 5–12 mm. wide, glabrous on the lower surface, scabrous and sparsely papillose-hispid on the upper, the margins very scabrous; panicles mostly 4–8 cm. long (rarely as much as 15 cm., those of the branches

often much reduced), the branches narrowly ascending to spreading, the lower rarely more than 5 cm. long, densely flowered, sometimes naked at the base; spikelets 1.5 mm. long, oval, the first glume minute, nerveless; fruit oval, smooth and shining, sparsely pilose with long appressed hairs.

In brush on rocky slopes, along fences, and in moist forests, Mexico (Veracruz) to Panama.

CHIRIQUÍ: El Boquete, *Hitchcock 8317.*

31. PANICUM SCHIFFNERI Hack. Ergeb. Bot. Exped. Akad. Wiss. Südbras. 11. 1906.

Perennial; culms mostly 1–2 m., sometimes as much as 3 m. long, straggling or clambering, rather woody, freely branching, rooting at the nodes, retrorsely pilose, especially below the nodes, or sometimes nearly glabrous; sheaths much shorter than the internodes, pilose or papillose-pilose; blades 5–15 cm. long, 1–2.5 cm. wide, lanceolate, acuminate, somewhat asymmetrical, sparsely pilose, the margins scabrous; panicles pyramidal, 10–15 cm. long, nearly as wide, the branches ascending to spreading, at least some of the branches naked at the base; spikelets 1.5 mm. long, elliptic, densely clustered on the short branchlets, glabrous, the first glume minute, nerveless; fruit 1.5 mm. long, sparsely pilose with long silky hairs.

Wet shady banks, often clambering in brush, southern Mexico (Veracruz) and the West Indies to Brazil.

CHIRIQUÍ: El Boquete, *Hitchcock 8278, 8305.*

32. PANICUM CORDOVENSE Fourn. Mex. Pl. 2:26. 1886.
Panicum expansum Fourn. Mex. Pl. 2:26. 1886.
Ichnanthus apiculatus Scribn. U. S. Dept. Agr. Div. Agrost. Circ. 30:1. 1901.

Perennial; culms as much as 2 m. long, rather slender, widely spreading or straggling, rooting at the nodes, branching, the branches elongate; sheaths much shorter than the internodes, sparsely to rather densely papillose or papillose-hispid, the margins densely ciliate; blades 5–15 cm. long, 5–10 mm. wide, narrowly lanceolate, acuminate, rounded at the base, sparsely hispid, the midnerve and margins white, very scabrous; primary branches 8–20 cm. long, loosely flowered, the branches ascending or spreading, some long, some short in the same fascicle, the secondary panicles terminal on the branches and branchlets, narrow, much reduced, partly enclosed in the sheath; spikelets 3–3.5 mm. long, usually paired, the pairs rather distant, glabrous or pustulose-pubescent, the first glume subobtuse, two-thirds to three-fourths as long as the spikelet.

Open or brushy slopes and shady woods, Mexico (Veracruz) to Brazil and Bolivia.

CHIRIQUÍ: Volcán Chiriquí, *Hitchcock 8196;* El Boquete, *Hitchcock 8271, 8275, 8303, 8328.*

33. PANICUM PANTRICHUM Hack. Verh. Zool. Bot. Ges. Wien. 1915:72. March, 1915.

Panicum chiriquiense Hitchc. & Chase, Contr. U. S. Nat. Herb. 17:527. *f. 138.* July, 1915.

Panicum protractum Mez, Notizbl. Bot. Gart. Berlin 7:77. 1917.

Perennial; culms as much as 80 cm. long, straggling, rooting at the nodes, the ascending branches 20–30 cm. high, papillose or papillose-pilose; sheaths overlapping or somewhat shorter than the internodes, densely papillose-pilose with usually spreading hairs; blades 2–7 cm. long, 7–10 mm. wide, acuminate, rounded at the base, densely pubescent or pilose on both surfaces; panicles 2.5–3.5 cm. long, or the primary ones as much as 10 cm. long, the branches stiffly ascending, villous; spikelets 2.7 mm. long, pubescent, the first glume three-fourths as long as the spikelet; fruit 2.1 mm. long, minutely apiculate.

Shady hillsides, Panama to Brazil.

CHIRIQUÍ: El Boquete, *Hitchcock 8313* (TYPE); Bajo Boquete, *Killip 456*.

34. PANICUM STENODOIDES F. T. Hubb. Proc. Amer. Acad. 49:497. 1913.

Perennial; culms 20–40 cm. high, densely tufted, slender, erect with slender leafless panicle-bearing branches from the upper nodes; sheaths papillose-pilose or nearly glabrous, the lowermost bladeless, becoming fibrous; ligule scarcely 0.5 mm. long, membranaceous, minutely ciliate; blades 3–8 cm. long, 1–2 mm. wide, involute at least toward the tip, papillose-pilose or sometimes glabrous; panicles about 1 cm. long, narrow, short-exserted, bearing 3–7 appressed spikelets; spikelets 2–2.1 mm. long, attenuate at the base, the first glume acute, about half as long as the spikelet; fruit 1.7 mm. long.

Moist wet open grassland, British Honduras, Costa Rica, Panama, Trinidad, and Brazil.

CANAL ZONE: Frijoles, *Killip 4346;* between Panamá and Corozal, *Hitchcock 9207;* Rio Azote Caballo, *Dodge, Steyermark & Allen 16850.* PANAMÁ: Chorrera, *Hitchcock 8147.*

35. PANICUM ALTUM Hitchc. & Chase, Contr. U. S. Nat. Herb. 17:488. *f. 57.* 1915.

Perennial; culms 2–4 m. long, stout, reed-like, tangled, decumbent and straggling at the base, glaucous, sometimes with erect sterile branches at the swollen nodes; sheaths smooth; blades 30–45 cm. long, 8–15 mm. wide, glabrous on both surfaces, the margins scabrous; panicles 20–30 cm. long, the slender scabrous branches fascicled, ascending to spreading, some of them naked at the base; spikelets 3.2–4 mm. long, short-pedicellate, turgid, glabrous, gaping, the first glume pointed, about two-thirds as long as the spikelet; fruit 2–2.2 mm. long.

Marshes near the seacoast, British Honduras to Trinidad.

PANAMÁ: Point Chamé, *Hitchcock 8167* (TYPE).

36. PANICUM MAXIMUM Jacq. Coll. Bot. 1:76. 1786.

Panicum polygamum Swartz, Prodr. Veg. Ind. Occ. 24. 1788.
Panicum laeve Lam. Tabl. Encycl. 1:172. 1791.
Panicum jumentorum Pers. Syn. Pl. 1:83. 1805.
Panicum scaberrimum Lag. Gen. & Sp. Nov. 2. 1816.
Panicum trichocondylum Steud. Syn. Pl. Glum. 1:74. 1854.

Perennial with stout rhizomes; culms usually in large clumps, 1–2.5 m. high,

erect or sometimes geniculate at the lower nodes, the nodes usually densely hirsute; sheaths shorter than the internodes, papillose-hirsute or nearly glabrous; ligule 4–6 mm. long, densely ciliate; blades elongate, 1–2 cm. wide, narrowed toward the base, the margins very scabrous; panicles 20–45 cm. long, the branches ascending or spreading, somewhat drooping at maturity, in rather distant whorls, naked toward the base, pilose in the axils; spikelets 3 mm. long, acute, glabrous, the first glume obtuse, about one-third as long as the spikelet; fruit 2.3–2.5 mm. long, transversely rugose.

Introduced in America from Africa; Florida, Mexico, and the West Indies to Bolivia and Brazil. Commonly cultivated for forage, escaping in fields and waste places.

Guinea grass.

CANAL ZONE: Gamboa, *Standley 28490;* Culebra, *Hitchcock 7920; Pittier 2088, 4806;* Ancón Hill, *Maxon 6781;* Balboa, *Standley 25541, 25549.* PANAMÁ: Taboga Island, *Hitchcock 8080.*

37. PANICUM MERTENSII Roth in Roem. & Schult. Syst. Veg. 2:458. 1817.

Panicum altissimum G. Meyer, Prim. Fl. Esseq. 63. 1818. Not *P. altissimum* DC 1817.
Panicum megiston Schult. Mant. 2:248. 1824.
Panicum elatius Kunth, Rév. Gram. 1:38. 1829.
Panicum tuberculatum Presl, Rel. Haenk. 1:307. 1830.

Perennial; culms 1–2 m. high., coarse, erect; sheaths shorter than the internodes, papillose or papillose-pilose toward the summit, nearly glabrous toward the base, somewhat auriculate; ligule membranaceous, truncate, 2–3 mm. long; blades 15–40 cm. long, 1.5–3 cm. wide, somewhat narrowed to a rounded base, glabrous on both surfaces, the margins scabrous; panicles 40–60 cm. long, the long, angular, nearly simple, ascending branches in dense rather distant verticils, pubescent and hispid in the axils, naked in the lower half; spikelets 3.5 mm. long, glabrous, short-pedicellate, paired, the pairs distant, the first glume acute, about one-third as long as the spikelet; fruit 2.8 mm. long, pointed, smooth and shining.

Marshes, moist woods and waste places, Mexico (Tabasco) and Cuba to Paraguay.

CANAL ZONE: Barro Colorado Island, *Kenoyer 123;* Empire, *Pittier 3726;* Bohio, *Hitchcock 7944.* PANAMÁ: Matías Hernández, *Pittier 6717.*

38. PANICUM GRANDE Hitchc. & Chase, Contr. U. S. Nat. Herb. 17:529. *f. 143.* 1915.

Stoloniferous perennial; culms 1.5–2 m. high, erect from a long decumbent base, 1–2 cm. thick, simple or sparingly branched, the nodes densely appressed-hirsute; sheaths mostly longer than the internodes, papery or somewhat succulent, sparsely hispid at the throat; ligule membranaceous, about 2 mm. long; blades of the midculm as much as 1 m. long, 6 cm. wide, the upper and lower one smaller, the margins serrulate; panicles 30–60 cm. long, 10–40 cm. wide, the axis rather deeply furrowed, the branches stiffly ascending, naked at the base, the lower ones whorled, mostly 20–30 cm. long; spikelets 2.5 mm. long, short-pedicellate, ap-

pressed to the branchlets, pointed, glabrous, the first glume acute, a little more than half as long as the spikelet; fruit 1.8 mm. long, obovate, smooth and shining.

Swamps, often growing in large masses in water, Nicaragua and Trinidad to Venezuela.

COLÓN: Catival, *Standley 30391*. CANAL ZONE: Gatún, *Hitchcock 9178* (TYPE); Juan Mina, *Bartlett & Lasser 16751, 16879;* Gamboa, *Standley 28495;* Sambú River, *Pittier 5546*. PANAMÁ: Río Chagres, *D. H. Popenoe 38; Piper 5241;* Río Tecúmen, *Standley 26517*.

39. PANICUM ZIZANIOIDES H.B.K. Nov. Gen. & Sp. 1:100. 1815.

Panicum oryzoides Swartz, Prodr. Veg. Ind. Occ. 23. 1788. Not *P. oryzoides* Ard., 1764.
Panicum pseudoryzoides Steud. Syn. Pl. Glum. 1:75. 1854.
Acroceras oryzoides Stapf in Prain, Fl. Trop. Afr. 9:622. 1920.
Acroceras zizanioides Dandy, Jour. Bot. Brit. & For. 69:54. 1931.

Perennial; culms 50 cm. to as much as 2 m. long, decumbent-spreading, rooting at the nodes, the lower internodes short; sheaths mostly shorter than the internodes, glabrous or papillose-hispid toward the summit; hispid in the throat, the margins ciliate; ligule about 0.5 mm. long, membranaceous; blades 4–15 cm. long, 8–30 mm. wide, acuminate, cordate, the margins very scabrous; panicles 10–25 cm. long, the few rather distant branches stiffly ascending or spreading, nearly simple; spikelets paired, rather short-pedicellate, appressed, 5.5–6 mm. long, glabrous; first glume broad, clasping, about two-thirds as long as the spikelet; second glume and sterile lemma equal, laterally compressed and keeled at the summit; fruit 4.7–5 mm. long, smooth and shining, laterally compressed at the summit forming a small crest.

Woods, swamps, and moist open ground, Mexico (Veracruz) and the West Indies to Paraguay.

BOCAS DEL TORO: Pumpkin River, *von Wedel 2579;* Changuinola Valley, *Dunlap 202, 230*. CHIRIQUÍ: David, *Hitchcock 8351*. COLÓN: Río Sirri, *Pittier 4026*. CANAL ZONE: Barro Colorado Island, *Kenoyer 121;* Juan Mina, *Bartlett & Lasser 16411, 16525, 16750;* Gamboa, *Pittier 3781, 4790;* Tabernilla, *Hitchcock 8112, 8385;* Fort Kobe road, *Woodson, Allen & Seibert 1413;* Balboa, *Standley 25440, 29253*. PANAMÁ: La Jagua, *Bartlett & Lasser 16389, 16987, 16991;* Taboga Island, *Killip 4137*.

54. ICHNANTHUS Beauv.

ICHNANTHUS Beauv. Ess. Agrost. 56. *pl. 12. f. 1.* 1812.

Spikelets paniculate or arranged on one-sided racemes or raceme-like branches; first glume acuminate, often nearly as long as the spikelet; second glume and sterile lemma subequal, pointed beyond the fruit, usually acuminate; fruit acute or subacute, the margins of the lemma usually flat, the rachilla disarticulating at the base of the segment, remaining attached to the fruit as a short stipe, this bearing on either side membranaceous appendages adnate to the base of the lemma, the appendages or wings often much reduced or indicated only by scars.

Annuals or perennials of varying habit with relatively broad flat blades and terminal and axillary inflorescences.

a. Blades 1–6 cm. long, ovate to ovate-lanceolate, thin; plants annual, the culms very slender and rather weak.
  b. Inflorescences exserted on long slender peduncles, the branches usually spreading; blades 4–10 mm. wide, the margins not undulate; spikelets sparsely pilose. Plants forming dense soft mats ..... 1. I. TENUIS
  bb. Inflorescences short-exserted, or only the terminal long-exserted, the axillary ones usually partly enclosed in the sheaths, the branches appressed; blades 1–2 cm. wide, the margins undulate; spikelets glabrous ..... 2. I. NEMOROSUS
aa. Blades, or at least most of them, more than 6 cm. long, relatively firm, plants perennial, the culms stouter, sometimes clambering in brush.
  b. Blades ovate to ovate-lanceolate, 1.5–3.5 cm. wide; nodes villous; racemes approximate, stiffly ascending, the lower ones 2–4 cm. long ..... 3. I. AXILLARIS
  bb. Blades lanceolate, 5–15 mm. wide; nodes glabrous or nearly so; racemes relatively distant, the lower ones spreading, as much as 7 cm. long ..... 4. I. PALLENS

1. ICHNANTHUS TENUIS (Presl) Hitchc. & Chase, Contr. U. S. Nat. Herb. 18:334. 1917.

Oplismenus tenuis Presl, Rel. Haenk. 1:319. 1830.
Panicum exile Steud. Nom. Bot. ed. 2. 2:256. 1841.
Panicum alsinoides Griseb. Fl. Brit. W. Ind. 550. 1864.
Ichnanthus alsinoides Munro ex Hemsl. Biol. Centr.-Amer. Bot. 3:500 1885.

Annual; culms forming large loose mats, very slender, elongate, decumbent or creeping, rooting at the nodes, freely branching, the erect or ascending branches 10–40 cm. long, pubescent or pilose, rarely nearly glabrous; sheaths usually much shorter than the internodes, pilose or papillose-pilose with spreading hairs; blades ovate to ovate-lanceolate or lanceolate, 1–5 cm. long, 4–10 mm. wide, thin, glabrous to pubescent and sparsely pilose; inflorescences terminal and axillary, long-exserted on slender peduncles, composed of 2 to several slender to spreading racemes, pubescent or pilose in the axils, the lower ones 1–3 cm. long; spikelets 3–4 mm. long, appressed, sparsely pilose, especially on the margins of the glumes and sterile lemma; first glume acuminate or attenuate, almost aristate, two-thirds to nearly as long as the spikelet; second glume and sterile lemma acuminate, equal or the glume a little longer, extending beyond the fruit; fruit 2–2.5 mm. long, oblong-elliptic, the wings reduced to inconspicuous scars.

The spikelets are frequently proliferous and sterile, composed of few to several herbaceous lemmas.

Moist forests, thickets, and shady places, British Honduras and Trinidad to Colombia and Brazil.

BOCAS DEL TORO: Laguna de Chiriquí, *von Wedel 1122;* Water Valley, *von Wedel 1781, 1857.* CHIRIQUÍ: El Boquete, *Hitchcock 8274;* Cerro Vaca, *Pittier 5366, 5370.* CANAL ZONE: France Field, *Maxon & Valentine 7077;* Chagres, *Fendler 373;* Gatún, *Hitchcock 9186;* between Bohio and Frijoles, *Hitchcock 8394;* Barro Colorado Island, *Kenoyer 107;* Obispo, *Standley 31771;* Culebra, *Hitchcock 9166, 9167; Pittier 2119;* Summit, *D. H. Popenoe 2;* Ancón Hill, *Killip 4029, 4208; Standley 26383;* Las Cruces Trail, *Cornman 2609;* Balboa, *Hitchcock 8000; Standley 25608.* PANAMÁ: Chivi Chivi Trail, *Cornman 4314;* Río Indio, *Dodge & Allen 17296;* Río Tecúmen, *Standley 29441.* Without locality, *Haenke* (TYPE).

2. ICHNANTHUS NEMOROSUS (Swartz) Doell in Mart. Fl. Bras. 2^2:289. 1877.

Panicum nemorosum Swartz, Prodr. Veg. Ind. Occ. 22. 1788.

Milium nemorosum Moench, Meth. Pl. Suppl. 67. 1802.
Echinolaena nemorosa Kunth, Rév. Gram. 1:54. 1829.

Annual; culms slender, weak, decumbent-spreading, rooting at the nodes, 15–50 cm., or sometimes as much as 1 m. long, with relatively long internodes, villous in a line on one side, otherwise glabrous or nearly so; sheaths much shorter than the internodes except on young shoots, densely villous on the margins, glabrous or sparsely pilose on the back; blades ovate or ovate-lanceolate, acute or acuminate, asymmetric at the somewhat clasping base, 2–6 cm. long, 1–2 cm. wide, thin, with undulate margins, finely cross-veined, glabrous or sparsely hirsute on both surfaces, the margins finely scabrous; inflorescences terminal and axillary from the upper sheaths, the terminal rather long-exserted, the axillary usually partly enclosed, narrow, few-flowered, the branches short, appressed, or rarely spreading, villous in the axils; spikelets 3–3.5 mm. long, short-pedicellate, appressed, glabrous; first glume acute or acuminate, half to two-thirds as long as the spikelet, sometimes with an awn-point equalling or slightly exceeding the spikelet; second glume acuminate, slightly longer than the acute sterile lemma, the latter enclosing a well developed palea; fruit 2 mm. long, yellowish at maturity, wingless.

Forests and shady places, the West Indies and Guatemala to Panama.

BOCAS DEL TORO: Isla Colón, *von Wedel 1350.* CHIRIQUÍ: Volcán de Chiriquí, *Hitchcock 8195;* El Boquete, *Hitchcock 8329;* Monte Lirio, *Seibert 313.*

3. ICHNANTHUS AXILLARIS (Nees) Hitchc. & Chase, Contr. U. S. Nat. Herb. 18:334. 1917.

Panicum axillare Nees, Agrost. Bras. 141. 1829.

Perennial; culms decumbent-spreading, rooting at the nodes, sometimes clambering in brush, as much as 1–1.5 m. long, the erect or ascending shoots or branches mostly 10–20 cm. long, glabrous or sparsely pubescent, the nodes villous; sheaths much shorter than the internodes, or overlapping on new shoots, usually densely villous; ligule truncate, about 1 mm. long; blades ovate or ovate-lanceolate, 3–9 cm. (sometimes 12 cm.) long, 1.5–3.5 cm. wide, acute, scabrous above, usually glabrous beneath; inflorescences terminal and axillary from the upper sheaths, partly included to long-exserted, rather dense, composed of few to numerous, stiffly ascending, approximate racemes, rather densely pubescent or pilose in the axils, the lower ones 2–4 cm. long; spikelets 3 mm. long, glabrous or sparsely pilose; glumes acuminate, scabrous on the keel, the first half to two-thirds as long as the spikelet; sterile lemma acute or subacuminate, a little shorter than the second glume, containing a well-developed palea and a staminate flower; fruit 1.8–2 mm. long, oblong-elliptic, with prominent scars at the base.

Moist forests, thickets, and banks at lower altitudes, Guatemala and the West Indies to Ecuador and Brazil.

CHIRIQUÍ: El Boquete, *Hitchcock 8276;* San Felix, *Pittier 5203.* CANAL ZONE: Fort Sherman, *Standley 31126;* Frijoles, *Hitchcock 9398.* PANAMÁ: Juan Díaz, *Killip 4063;* Río Tapia, *Standley 26144, 28146.*

4. ICHNANTHUS PALLENS (Swartz) Munro ex Benth. Fl. Hongk. 414. 1861.

Panicum pallens Swartz, Prodr. Veg. Ind. Occ. 23. 1788.
Panicum hemignostum Steud. Syn. Pl. Glum. 1:77. 1854.

Perennial; culms decumbent or prostrate-spreading, sometimes clambering in brush, 50 cm. to more than 1.5 m. long, the erect or ascending shoots or branches as much as 55 cm. long, glabrous or sparsely pilose, the nodes not villous; sheaths much shorter than the internodes, glabrous or sparsely or rarely densely pilose or papillose-pilose, especially on the margins; ligule thin, erose or lacerate, about 1 mm. long; blades lanceolate, acuminate, 5–12 cm. long, mostly 5–15 mm. wide, rounded and somewhat clasping at the more or less asymmetric base, thin, scaberulous, finely cross-veined; inflorescences terminal and axillary from the upper sheaths, long-exserted or the axillary ones appressed and partly included, usually not dense, the rather slender racemes ascending, the lower ones as much as 7 cm. long; spikelets 3–3.5 mm. long, glabrous or sparsely pilose or hirsute; first glume acuminate, half to two-thirds as long as the spikelet, scabrous on the keel; second glume and sterile lemma acuminate, subequal or the glume a little longer, the lemma enclosing a palea nearly as long as the lemma and sometimes a staminate flower; fruit 2 mm. long, oblong-elliptic, the scars extending downward into very narrow wings.

The spikelets are sometimes proliferous.

Moist forests and shady places, low to medium altitudes, southern Mexico and the West Indies to Argentina.

BOCAS DEL TORO: Laguna de Chiriquí, *Hart 69, 72, 89;* Isla Colón, *von Wedel 1362;* Almirante, *Cooper 121;* Water Valley, *von Wedel 1577.* CHIRIQUÍ: El Boquete, *Hitchcock 8268, 8273, 8302, 8306, 8318;* San Felix, *Pittier 5204, 5230, 5272;* Bajo Chorro, *Woodson & Schery 687.* CANAL ZONE: Fort Randolph, *Standley 28663;* Margarita Swamp, *Maxon & Valentine 7052;* between France Field, Canal Zone, and Catival, Colón, *Standley 30154, 30175, 30217;* Gatún, *Hitchcock 9181; Maxon 4654;* Frijoles, *Standley 27528;* Barro Colorado Island, *Standley 31350, 40805, 41024;* Empire to Mandinga, *Piper 5252;* Culebra, *Hitchcock 8023, 9164, 9210;* Summit, *D. H. Popenoe 2;* Las Cascadas Plantation, *Standley 25674;* between Panamá and Corozal, *Hitchcock 9201;* Ancón, *Piper 5227;* Ancón Hill, *Standley 26397;* Balboa, *Standley 29288.* PANAMÁ: Quebrada Salamanca, *Steyermark & Allen 17143;* Cañon of Río Chagres, *Steyermark & Allen 17505;* Alhajuela, *Pittier 2335;* Matías Hernández, *Pittier 6023;* Río Tapia, *Maxon & Harvey 6690; Hitchcock 22951;* Taboga Island, *Standley 27874.*

55. LASIACIS (Griseb.) Hitchc.

LASIACIS (Griseb.) Hitchc. Contr. U. S. Nat. Herb. 15:16. 1910.

Spikelets paniculate, subglobose, somewhat inflated, placed obliquely on the pedicels; glumes and sterile lemma papery, usually lanate-pubescent at the tip; first glume one-third to half as long as the spikelet, broad and clasping, the second glume and sterile lemma nearly equal, a little shorter to a little longer than the fertile floret; fruit bony-indurate, blunt, the lemma and palea with a tuft of short hairs from a minute depression at the tip, the margins of the lemma firm but not inrolled; palea convex above, the tip often free at maturity.

Trailing vines or coarse, woody, cane-like, high-clambering perennials with

fascicled branches and open or sometimes contracted panicles terminating the culm and leafy branches, the blades and panicles of the branches usually reduced.

a. Blades cordate-clasping, usually elongate, as much as 5 cm. wide ..... 1. L. PROCERRIMA
aa. Blades not cordate-clasping.
b. Plants without a strong central cane, creeping or low-clambering, rooting at the nodes.
c. Ligule 0.5–1 mm. long, pale, truncate. Panicles loosely flowered, the spikelets in pairs at the ends of the branches and branchlets . 2. L. MAXONI
cc. Ligule 3–8 mm. long, dark brown, usually lacerate.
d. Panicles 5–6 cm. long, scarcely exserted from the sheath, the branches and branchlets finally stiffly spreading or reflexed ... 3. L. SCABRIOR
dd. Panicles more than 10 cm. long, the branches usually ascending.
e. Spikelets 5 mm. long. Culms smooth, shining, with a pubescent line down one side ..... 4. L. LUCIDA
ee. Spikelets 4 mm. long.
f. Ligule 5–8 mm. long; panicle branches few, distant, stiffly spreading or reflexed, the spikelets in clusters at the ends of the branchlets. Blades elliptic-lanceolate, mostly 2–2.5 cm. wide ..... 5. L. LONGILIGULA
ff. Ligule 2–5 mm. long; panicle branches slender, ascending, or if spreading, the spikelets not in clusters at the ends of the branchlets.
g. Culms glabrous; blades linear or linear-lanceolate, sometimes elongate, scabrous; panicles partly included in the sheath or only slightly exserted, the branches finally somewhat spreading ..... 6. L. OAXACENSIS
gg. Culms sparsely to densely strigose; blades narrowly elliptic-lanceolate, acuminate, softly pubescent on the lower surface; panicles exserted, the branches narrowly ascending or appressed ..... 7. L. STANDLEYI
bb. Plants with a strong central cane freely branching, erect or clambering over brush to a height of several meters.
c. Branches strongly zigzag; blades glabrous, narrowly lanceolate, mostly less than 1 cm. wide; panicles 5–10 cm. long, few-flowered 8. L. DIVARICATA
cc. Branches straight or arcuate; blades usually softly pubescent on the lower surface, at least those on the main branches more than 1.5 cm. wide; primary panicles large, more than 10 cm. long.
d. Blades narrowly lanceolate; panicles open, loosely flowered; spikelets 4–5 mm. long ..... 9. L. SORGHOIDEA
dd. Blades ovate-lanceolate or elliptic, often cordate-clasping at the base, asymmetric; panicles, or at least the branches, compactly flowered; spikelets 3–4 mm. long ..... 10. L. RUSCIFOLIA

1. LASIACIS PROCERRIMA (Hack.) Hitchc. Proc. Biol. Soc. Washington 24:145. 1911.

Panicum procerrimum Hack. Oesterr. Bot. Zeitschr. 51:431. 1901.

Culms coarse, semi-woody, 1–4 m. high, erect, single or usually several together in a loose clump, from a woody branching base, the upper internodes very short; sheaths glabrous, sometimes ciliate on the margins, the lower shorter than the internodes, the upper ones closely overlapping; ligule membranaceous, about 1 mm. long; blades 15–40 cm. long, 2–5 cm. wide, often distichous, acuminate, cordate-clasping, glabrous, the margins scabrous; panicles as much as 1 m. long, the lower branches whorled, naked below, ascending or finally spreading, diffuse, as much as 40 cm. long; spikelets 3 mm. long, the lateral ones short-pedicellate.

Wet or moist forests and thickets or brushy slopes, Mexico to Peru.

BOCAS DEL TORO: Laguna de Chiriquí, *von Wedel 1186*. CHIRIQUÍ: El Boquete, *Hitch-*

cock 8283. COLÓN: Fort Lorenzo, *Piper 5948.* CANAL ZONE: Gatún, *Hitchcock 7984;* between Frijoles and Bohio, *Hitchcock 8393;* Empire to Mandinga, *Piper 5280;* Summit, *Standley 30100;* between Pedro Miguel and Corozal, *Hitchcock 7961;* between Corozal and Ancón, *Pittier 6774;* Ancón, *Killip 4024;* Ancón Hill, *Killip 12066;* Balboa, *Standley 26055; Rowley & Stark 945.* PANAMÁ: Cerro Campana, *Bartlett 16902;* Arraiján, *Woodson, Allen & Seibert 1399;* Arenoso, lower Río Trinidád, *Seibert 628;* Taboga Island, *Hitchcock 8087; Standley 27055; Woodson, Allen & Seibert 1453.*

2. LASIACIS **maxoni** Swallen, sp. nov.

Culmi 1–2 m. longi, erecti vel vagantes, ramosi, glabri; vaginae inferiores internodiis breviores, superiores longiores, glabrae, in collo villosae; ligula 0.5–1 mm. longa, truncata, pallida; laminae 17–25 cm. longae, 11–26 mm. latae, acuminatae, glabrae vel scabrae; paniculae 20–35 cm. longae, ramis rigidis adscendentibus vel patentibus, ramulis divergentibus implicatis; spiculae 4 mm. longae, pallidae vel purpurascentes.

Culms coarse, woody, erect or straggling, without a central cane, 1–2 m. long, freely branching, glabrous; lower sheaths shorter, the upper much longer than the internodes, glabrous or with a villous line on the collar; ligule 0.5–1 mm. long, truncate, pale; blades 17–25 cm. long, 11–26 mm. wide, acuminate, gradually narrowed from near the base, glabrous or scabrous on both surfaces, the margins scabrous; panicles 20–35 cm. long, nearly as broad, loosely flowered, the slender to rather stout branches stiffly ascending or sometimes spreading, with a prominent pulvinus in the axils, branching at or near the base, the secondary branches and branchlets all divergent, implicate; spikelets 4 mm. long, in pairs at the ends of the branches and branchlets, pale or often purple.

Thickets and forest margins, Costa Rica and Panama.

CHIRIQUÍ: El Boquete, in thickets along wet trail, 1000–1300 m. alt., March 2-8, 1911, *Maxon 4999* (U. S. Nat. Herb., TYPE); *Hitchcock 8281;* between Hato and Cerro Vaca, *Pittier 5422.*

3. LASIACIS SCABRIOR Hitchc. Proc. Biol. Soc. Washington 40:85. 1927.

Culms clambering or straggling, as much as 3 m. long, much branched, the fruiting branches divaricately branched from all the nodes, papillose or papillose-pilose; sheaths papillose-hispid, densely villous on the margin, those of the fruiting branchlets much overlapping; ligule 3–5 mm. long, conspicuous, brown; blades 8–12 cm. long, 1–1.5 cm. wide, elliptic-lanceolate, acuminate, scabrous on the upper surface, pubescent on the lower, the pubescence sometimes sparse; panicles 5–6 cm. long, almost as broad, scarcely exserted from the sheath, rather dense, but finally most of the branches and branchlets divaricately spreading, or sometimes the lower ones reflexed, the axis and branches densely and minutely pubescent; spikelets 4 mm. long.

Moist or wet forests and thickets, Guatemala to Ecuador.

BOCAS DEL TORO: Changuinola Valley, *Dunlap 406.* COCLÉ: La Mesa, *Allen 2376;* El Valle de Antón, *Allen 1641, 2061.*

4. LASIACIS **lucida** Swallen, sp. nov.

Culmi vagantes, ramis adscendentibus 70 cm. altis, unifariam pubescentes,

pallidi vel purpurascentes, lucidi; vaginae internodiis breviores, glabrae vel ± papillosae vel papilloso-pilosae, marginibus villosis; ligula 6–7 mm. longa, fusca, lacerata; laminae 7–14 cm. longae, 6–12 mm. latae, acuminatae, glabrae, marginibus scabris; paniculae 10–25 cm. longae, ramis gracilibus adscendentibus, basi nudis, ramulis paucifloris appressis; spiculae 5 mm. longae, pedicellis scabris.

Culms straggling, without a strong central cane, the ascending branches about 70 cm. high, glabrous with a pubescent line down one side, pale or tinged with purple, shining; sheaths glabrous or more or less papillose or papillose-pilose, the margins villous, all much shorter than the internodes except the few uppermost ones on the flowering branches; ligule 6–7 mm. long, brown, lacerate; blades 7–14 cm. long, 6–12 mm. wide, acuminate, glabrous, the margins scabrous; panicles 10–25 cm. long, the slender branches ascending, glabrous or sparsely hairy in the axils, pubescent at the base, naked for 2–3 cm. at the base, the branchlets few-flowered, appressed; spikelets 5 mm. long, the pedicels scabrous.

Moist forests, Costa Rica and Panama.

CHIRIQUÍ: Volcán de Chiriquí, above Sabana de El Salto, on trail to Camp Aguacatal, alt. 1500–1750 m., March 10-13, 1911, *Maxon 5266* (U. S. Nat. Herb., TYPE).

5. LASIACIS **longiligula** Swallen, sp. nov.

Culmi suberecti vel vagantes, 1–2 m. longi; vaginae glabrae vel papilloso-hispidae, marginibus dense ciliatis; ligula fusca, 5–8 mm. longa; laminae elliptico-lanceolatae, 10–17 cm. longae, 1–2 cm. latae, supra scabrae, infra minute pubescentes; paniculae 10–25 cm. longae, pauciramosae, ramis adscendentibus in parte inferiore nudis; spiculae 4 mm. longae, subglobosae, ad apices ramulorum glomeratae.

Culms suberect or straggling, mostly 1–2 m. long; sheaths glabrous to papillose-hispid, densely ciliate on the margins; ligule prominent, 5–8 mm. long; blades elliptic-lanceolate, 10–17 cm. long, 1–2.5 cm., or rarely 3 cm. wide, scabrous on the upper surface, minutely pubescent beneath, the margins scabrous; panicles 10–25 cm. long, the few solitary branches stiffly ascending, naked in the lower third or half, the spikelets clustered toward the ends of the branches and branchlets; spikelets 4 mm. long, subglobose, pale.

Moist forests, Costa Rica and Panama.

PANAMÁ: Río Indio, trail towards Chico, Jan. 12, 1935, *Steyermark & Allen 17435* (U. S. Nat. Herb., TYPE).

6. LASIACIS OAXACENSIS (Steud.) Hitchc. Proc. Biol. Soc. Washington 24:145. 1911.

Panicum oaxacense Steud. Syn. Pl. Glum. 1:73. 1854.

Culms relatively slender, as much as 3 m. long, erect or usually reclining, rooting at the nodes, with no strong central cane, the ascending branches often 1–2 m. long, glabrous; sheaths glabrous on the back, densely villous on the margins; ligule conspicuous, 2–5 mm. long, brown; blades narrowly lanceolate, acuminate, 14–22 cm. long, 7–20 mm. wide, glabrous, the margins scabrous;

panicles 10–25 cm. long, the branches ascending to spreading, glabrous in the axils, usually naked in the lower half, the branchlets narrowly ascending, not implicate, bearing a few spikelets at the ends; spikelets 4 mm. long, roughly globose, usually appressed.

Moist forests and thickets, banks of streams, and moist open ground, Mexico and the West Indies to Peru.

BOCAS DEL TORO: Old Bank Island, *von Wedel 2086;* Changuinola Valley, *Dunlap 166a, 394;* Almirante, *Cooper 105.* CHIRIQUÍ: Volcán de Chiriquí, *Hitchcock 8201;* El Volcán, *White 218;* Monte Lirio, *Seibert 278.* CANAL ZONE: between France Field, Canal Zone, and Cativa1, Colón, *Standley 30230;* Gatún, *Maxon 4653; Hitchcock 9174;* Frijoles, *Killip 4284; Standley 27410;* Darién, *Standley 31609; Killip 4306;* Gamboa, *Standley 28535;* Empire to Mandinga, *Piper 5278;* Cerro Gordo, near Culebra, *Standley 26009.* PANAMÁ: Juan Díaz, *Killip 4222, 4263; Standley 30591.*

7. LASIACIS STANDLEYI Hitchc. Proc. Biol. Soc. Washington 40:86. 1927.

Culms straggling, without a strong central cane, rooting at the lower nodes, with rather short internodes, the ascending branches 60–100 cm. long, pilose or papillose-pilose, densely villous just below the panicle; sheaths papillose or usually papillose-pilose, the margins densely ciliate, those of the main culm shorter than the internodes, those of the branches usually about as long as or longer than the internodes; ligule 3–5 mm. long, brown; blades 8–12 cm. long, 5–12 mm. wide, lanceolate or lanceolate-elliptic, acuminate, glabrous or minutely pubescent above, densely and softly pubescent to nearly glabrous beneath; panicles 13–19 cm. long, the solitary distant branches narrowly ascending or somewhat spreading, pubescent at the base, villous in the axils, the branchlets appressed; spikelets 4 mm. long, appressed, the pedicels usually sparsely pilose.

Open forests and jungle margins, Costa Rica and Panama.

CHIRIQUÍ: El Boquete, *Hitchcock 8267; Killip 4529;* New Switzerland, *Allen 1338.*

8. LASIACIS DIVARICATA (L.) Hitchc. Contr. U. S. Nat. Herb. 15:16. 1910.

Panicum divaricatum L. Syst. Nat. ed. 10. 2:871. 1759.
Panicum bambusioides Desv. ex Hamilt. Prodr. Pl. Ind. Occ. 10. 1825.
Panicum chauvinii Steud. Syn. Pl. Glum. 1:68. 1854.
Panicum divaricatum β. stenostachyum Griseb. Fl. Brit. W. Ind. 551. 1864.

Culms clambering, with a strong central cane, as much as 4 m. long, freely branching, glabrous or sometimes sparsely pilose, the branches often fascicled, the secondary shoots strongly divaricate or zigzag; sheaths glabrous on the back, the margins densely villous; blades narrowly lanceolate, 5–15 cm. long, 5–15 mm. wide, glabrous, the margins scabrous; panicles commonly 5–8 cm. long, or the primary as much as 20 cm. long, the few-flowered scabrous and sparsely pilose branches 1–5 cm. long, spreading or reflexed, the panicles of the ultimate branchlets much reduced; spikelet 4 mm. long.

Thickets and forest borders, southern Florida, Mexico and the West Indies to Bolivia and northern Argentina.

PANAMÁ: Alhajuela, *Pittier 2342.*

9. Lasiacis sorghoidea (Desv.) Hitchc. & Chase, Contr. U. S. Nat. Herb. 18:338. 1917.

Panicum lanatum Swartz, Prodr. Veg. Ind. Occ. 24. 1788. Not *P. lanatum* Rottb., 1776.
Panicum sorghoideum Desv. ex Hamilt. Prodr. Pl. Ind. Occ. 10. 1825.
Panicum divaricatum var. *lanatum* Schlecht. & Chamisso, Linnaea 6:33. 1831.
Panicum praegnans Steud. Syn. Pl. Glum. 1:74. 1854.
Panicum lanatum β. *sorghoideum* Griseb. Fl. Brit. W. Ind. 551. 1864.
Panicum martinicense Griseb. Fl. Brit. W. Ind. 552. 1864.
Panicum swartzianum Hitchc. Contr. U. S. Nat. Herb. 12:140. 1908.
Lasiacis swartziana Hitchc. Bot. Gaz. 51:302. 1911.

Robust with a strong central cane; culms erect or clambering, 2–7 m. high, freely branching, the main branches as much as 1 m. long, arcuate, drooping, or the branchlets fascicled on the main culm; sheaths papillose-hirsute to glabrate with a densely villous line on the collar, those of the main culm and branches shorter than the internodes, those of the branchlets longer than the internodes, often somewhat crowded; ligule inconspicuous; blades lanceolate, symmetrical, velvety on both surfaces or nearly glabrous above, those of the main culm as much as 20 cm. long and 3 cm. wide, those of the branches mostly 8–15 cm. long, 1–3 cm. wide, and those of the ultimate branches frequently much smaller; panicles of the main branches 10–20 cm. long, open and comparatively loosely many-flowered, the panicles of the fascicled and ultimate branches usually much reduced; spikelets 4–5 mm. long.

Sometimes called Carricillo in the Canal Zone.

Thickets, ravines, and forest borders, Mexico and the West Indies to Bolivia and Argentina.

Chiriquí: El Boquete, *Hitchcock 8269, 8270, 8282, 8286, 8311, 8315; Killip 4544; Davidson 710;* Cerro Vaca, *Pittier 5331, 5339.* Canal Zone: Toro Point, *Hitchcock 8054;* Chagres, *Fendler 371;* between France Field, Canal Zone, and Catival, Panamá, *Standley 30153;* Gatún, *Hitchcock 9175, 9177, 9182;* Barro Colorado Island, *Standley 40837;* Gamboa, *Standley 28320;* Ancón Hill, *Killip 4028; Piper 5281; Williams 4;* Las Cascadas Plantation, *Standley 25775, 29523;* Summit, *Allen 2281;* Pedro Miguel, *Hitchcock 7955;* Red Tank to Pueblo Nuevo, *Piper 5219;* between Miraflores and Corozal, *Pittier 2196;* Corozal, *Killip 4186;* Culebra, *Pittier 2118; Standley 25955, 25987, 26001;* Balboa, *Hitchcock 8003; Standley 25452, 26065, 29319; Greenman & Greenman 5052.*

10. Lasiacis ruscifolia (H.B.K.) Hitchc. Proc. Biol. Soc. Washington 24:145. 1911.

Panicum ruscifolium H.B.K. Nov. Gen. & Sp. 1:101. 1815.
Panicum compactum Swartz, Adnot. Bot. 14. 1829. Not *P. compactum* Kit., 1814.
Panicum liebmannianum Fourn. Mex. Pl. 2:33. 1886.
Lasiacis compacta Hitchc. Bot. Gaz. 51:302. 1911.
Lasiacis liebmanniana Hitchc. Proc. Biol. Soc. Washington 24:145. 1911.

Very robust with a strong central cane, clambering culms several meters high, usually glabrous, freely branching; sheaths usually shorter, sometimes a little longer than the internodes, glabrous or rarely hispid, the margins glabrous or simetimes villous; ligule inconspicuous; blades usually asymmetrical, ovate-lanceolate to lanceolate, acuminate, the primary ones 10–15 cm. long, 3–6 cm. wide, those of

the branches, especially the secondary branches, often much smaller, softly pubescent to glabrous on the lower surface, the upper surface glabrous or scabrous; panicles 5–20 cm. long, narrow, compact, or the lower branches somewhat distant and spreading, but densely flowered, the whole panicle sometimes open with implicate loosely flowered branches; spikelets 3–4 mm. long, green, nearly globose, at least at maturity.

Commonly called Carrizo.

Forests, thickets, and brushy slopes, West Indies; Mexico to Peru and Argentina.

BOCAS DEL TORO: Water Valley, *von Wedel 1856.* COCLÉ: Aguadulce, *Pittier 4987, 4998;* Río Mata Ahogado, *Allen 142.* VERAGUAS: headwaters of Río Cañazas, *Allen 176.* HERRERA: Pese, *Allen 797.* CANAL ZONE: Gatuncillo, *Piper 5257;* Río Abajo, *Bartlett 16397;* Pedro Miguel, *Killip 4311;* between Panamá and Corozal, *Hitchcock 9204;* Balboa, *Hitchcock 8060; Standley 25258, 25438, 26077, 29318, 32134.* PANAMÁ: Matías Hernández, *Pittier 6892;* Chepo, *Pittier 4688;* Panamá, *Hitchcock 8401; Standley 26890;* Bella Vista, *Killip 4040, 12011; Standley 25302;* Punta Paitilla, *Standley 30807, 30809;* Tropicho Island, *Allen 2624;* Taboga Island, *Hitchcock 8068; Killip 4157; Standley 27017, 27870; Pittier 3603; Allen 137, 1290; McBride 2788.*

56. SACCIOLEPIS Nash

SACCIOLEPIS Nash in Britton, Man. 89. 1901.

Spikelets oblong-conic; first glume acute, 3- to 5-nerved, small to half as long as the spikelet; second glume broad, inflated-saccate, strongly many-nerved; sterile lemma narrower, flat, usually 5-nerved, the palea well developed and often enclosing a staminate flower; fruit much smaller than the spikelet, very short-stipitate, chartaceous-indurate, the margins inrolled, the palea free at the summit.

Erect or decumbent spreading annuals or perennials of wet soil, with linear blades and usually dense elongate spike-like panicles.

a. Spikelets 2 mm. long, sparsely pilose; plants annual, usually erect, not decumbent-spreading or rooting at the nodes ..... 1. S. MYUROS
aa. Spikelets 4 mm. long, glabrous; plants perennial, usually decumbent-spreading, rooting at the nodes ..... 2. S. STRIATA

1. SACCIOLEPIS MYUROS (Lam.) Chase, Proc. Biol. Soc. Washington 21:7. 1908.

Panicum myuros Lam. Tabl. Encycl. 1:172. 1791.
Panicum myosurus L. Rich. Act. Soc. Hist. Nat. Paris 1:106. 1792.
Hymenachne myuros Beauv. Ess. Agrost. 49, 165. 1812.
Panicum phleiforme Presl, Rel. Haenk. 1:302. 1830.

Slender annual; culms usually erect, 10 cm. to as much as 1 m. high; sheaths glabrous, longer than the internodes; blades mostly 10–25 cm. long, 3–5 mm. wide, or smaller in depauperate specimens, glabrous or rarely sparsely hairy; panicles spike-like, 5–25 cm. long (commonly 10–15 cm.), about 5 mm. thick; spikelets 2 mm. long, sparsely pilose.

Wet savannas, marshes, fields, and along streams, at low altitudes, Mexico and Cuba, to Bolivia and Brazil.

COCLÉ: Aguadulce, *Pittier 4916, 4920.* CANAL ZONE: Corozal, *Killip 4243.* PANAMÁ: Matías Hernández, *Standley 28905, 31983;* Nuevo San Francisco, *Standley 30747;*

Panamá, *Standley 27802;* mouth of Pacora River, *Killip 4210;* Río Tecúmen, *Standley 26624;* between Río Chilibre and Alhajuela, *Pittier 2327.*

2. Sacciolepis striata (L.) Nash, Bull. Torrey Club 30:383. 1903.

Holcus striatus L. Sp. Pl. 1048. 1753.
Panicum striatum Lam. Tabl. Encycl. 1:172. 1791.
Sorghum striatum Beauv. Ess. Agrost. 132, 165. 1812.
Panicum gibbum Ell. Bot. S. C. & Ga. 1:116. 1816.
Panicum aquaticum Muhl. Descr. Gram. 126. 1817. Not *P. aquaticum* Poir., 1816.
Panicum hydrophilum Schult. Mant. 2:237. 1824.
Panicum elliottianum Schult. Mant. 2:256. 1824.
Panicum aquaticum Bosc ex Spreng. Syst. Veg. 1:319. 1825. Not *P. aquaticum* Poir., 1816.
Hymenachne striata Griseb. Fl. Brit. W. Ind. 554. 1864.
Sacciolepis gibba Nash in Britton, Man. 89. 1901.
Sacciolepis striata forma *gibba* Fernald, Rhodora 44:381. 1942.

Perennial; culms commonly 1–2 m. long, usually decumbent-spreading, rooting at the lower nodes, glabrous; sheaths, except the uppermost, shorter than the internodes, glabrous or more or less papillose-hirsute, the margins ciliate; ligule very short, minutely ciliate; blades 4–20 cm. long, 2–5 mm., rarely 15 mm., wide, glabrous or sparsely pilose, the margins scabrous; panicles 6–20 cm. long, narrow and rather dense, interrupted, especially toward the base, the branches appressed; spikelets 4 mm. long, glabrous; fruit about 1.6 mm. long.

Marshes, ditches, and wet places, sometimes floating in water, southeastern United States, West Indies, and Panama.

Canal Zone: Barro Colorado Island, *Bailey & Bailey 387.*

57. HYMENACHNE Beauv.

Hymenachne Beauv. Ess. Agrost. 48. *pl. 10. f. 8.* 1812.

Spikelets acuminate, short-pedicellate in dense spike-like or interrupted panicles; first glume acute or acuminate, 3- to 5-nerved, one-third to half as long as the spikelet, remote, a distinct stipe below the second glume; second glume and sterile lemma exceeding the fruit, 5-nerved, acuminate, the lemma longer than the glume, the tip awn-like; fruit membranaceous, pale, the margins of the lemma not inrolled, the tip of the palea not enclosed.

Coarse aquatic perennials with long, broad, cordate clasping blades and long, spike-like or open panicles with spreading densely flowered branches.

a. Panicles spike-like, dense; spikelets 3–4 mm. long, the second glume and sterile lemma rather prominently scabrous on the nerves ..... 1. H. amplexicaulis
aa. Panicles not spike-like, the branches ascending to spreading, the lower ones 5–10 cm. long; spikelets 2–2.5 mm. long, the second glume and sterile lemma scabrous only on the midnerve ..... 2. H. donacifolia

1. Hymenachne amplexicaulis (Rudge) Nees, Agrost. Bras. 276. 1829.

Panicum hymenachne Desv. Opusc. 82. 1831.
Agrostis monostachya Poir. in Lam. Encycl. Suppl. 1:256. 1810.
Panicum amplexicaule Rudge, Pl. Guian. 1:21. *pl. 27.* 1805.

Coarse aquatic perennial; culms succulent, slender or usually rather thick, sparingly branching, glabrous, the base creeping, rooting at the nodes, 1–2 m. long,

or even longer; sheaths usually shorter than the internodes, glabrous or sometimes ciliate on the margins; blades commonly 15–35 cm. long, 1.5–3 cm. wide, or smaller on some of the branches, acuminate, gradually narrowed from the cordate-clasping base, the margins scabrous, more or less papillose-hispid-ciliate at the base; panicles 20–50 cm. long, sometimes shorter, 8–15 mm. thick, dense, spike-like, the lower branches often distant; spikelets 3–4 mm. long, acuminate, the second glume and sterile lemma rather prominently scabrous on the nerves, the lemma often awn-pointed.

Swamps, ditches, and margins of rivers, lakes, and streams, sometimes in water 3–4 feet deep. Tropics of both hemispheres; southern Mexico and the West Indies to Argentina.

COCLÉ: Aguadulce, *Pittier 4908*. CANAL ZONE: Gatún, *Hitchcock 8030;* Juan Mina, *Killip 4167;* Barro Colorado Island, *Standley 21465; D. H. Popenoe 45*. DARIÉN: Sambú River, *Pittier 5530*.

2. HYMENACHNE DONACIFOLIA (Raddi) Chase, Jour. Washington Acad. Sci. 13:177. 1923.

Panicum donacifolium Raddi, Agrost. Bras. 44. 1823.
Panicum auriculatum Willd. in Spreng. Syst. Veg. 1:322. 1825.
Hymenachne auriculata Chase, Proc. Biol. Soc. Washington 21:5. 1908.

Similar in habit, appearance, and vegetative characters to *H. amplexicaulis;* blades usually widened above the base, more or less asymmetric, as much as 5.5 cm. wide; panicles mostly 25–35 cm. long, attenuate, dense, the branches rather slender but densely flowered, narrowly ascending to somewhat spreading, the lower ones 5–10 cm. long, floriferous to the base; spikelets 2–2.5 mm. long, acute, the second glume and sterile lemma scabrous on the midnerve, but not prominently as in *H. amplexicaulis*.

Swamps, ditches, and river banks and margins, often in water a few feet deep, Cuba; Costa Rica; Panama. Trinidad to Bolivia and Argentina.

CANAL ZONE: Gatún swamp, *Hitchcock 9170;* Juan Mina, *Bartlett & Lasser 16880*. PANAMÁ: Río Tecúmen, *Standley 26494*.

58. HOMOLEPIS Chase

HOMOLEPIS Chase, Proc. Biol. Soc. Washington 24:146. *f. 12*. 1911.

Spikelets lanceolate-acuminate, rather large, in open panicles; glumes similar, equal, or the first a little shorter, 7- to 9-nerved, completely covering the sterile lemma and fertile floret; sterile lemma thinner than the glumes, 7-nerved, villous between the lateral nerves, the back flat, the margins clasping the fertile floret; fruit acuminate, indurate, smooth and shining, the margins of the lemma broad, flat, or inrolled toward the tip.

Stoloniferous perennials with short flat blades and small narrow open panicles of large spikelets.

1. HOMOLEPIS ATURENSIS (H.B.K.) Chase, Proc. Biol. Soc. Washington 24:146. *f. 12.* 1921.

Panicum aturense H.B.K. Nov. Gen. & Sp. 1:103. *pl. 33.* 1815.
Panicum blepharophorum Presl, Rel. Haenk. 1:312. 1830.
Panicum tumescens Trin. Mém. Acad. St. Pétersb. VI. Sci. Nat. 3^2:316. 1834.

Stoloniferous perennial, the stolons determinate; culms slender, erect or ascending, sometimes geniculate, commonly 15–50 cm. long, or sometimes longer, glabrous; sheaths mostly shorter than the internodes, slightly inflated, glabrous on the back, with a pubescent line on collar, villous-ciliate on the margins; ligule about 0.5 mm. long, truncate, minutely ciliate; blades lanceolate, 5–12 cm. long, 1–1.5 cm. wide, acute, rounded or subcordate at the base, minutely cross-veined, the margins scabrous or sometimes very sparsely-ciliate; stolon blades mostly 3–5 cm. long, 8–10 mm. wide; panicles 5–10 cm. long, narrow, the slender few-flowered branches narrowly ascending or appressed; spikelets about 7 mm. long, acuminate, glabrous.

Moist forests, margins of swamps and ditches, and moist open ground, sometimes a weed in cultivated places, Mexico to Bolivia and Brazil.

BOCAS DEL TORO: Isla Colón, *von Wedel 2801;* Old Bank Island, *von Wedel 2064.* CHIRIQUÍ: El Boquete, *Hitchcock 8352.* CANAL ZONE: Toro Point, *Hitchcock 8051;* Chagres, *Fendler 370;* Fort Sherman, *Standley 30997; Maxon & Valentine 7031;* between Mindi and Colón, *Hitchcock 7940;* Darién, *Standley 31558;* between Gorgona and Tabernilla, *Hitchcock 7963;* Juan Mina, *Piper 5268;* Empire, *Pittier 3727;* Culebra, *Hitchcock 7893;* Summit, *Standley 30071; Muenscher 12211;* between Corozal and Ancón, *Pittier 2635;* Ancón Hill, *Killip 4196.* PANAMÁ: Orange River, *Cornman 2572;* Chorrera, *Hitchcock 8129;* Río Tecúmen, *Standley 26513;* Arraiján, *Woodson, Allen & Seibert 1379.* DARIÉN: Río Yapé, *Allen 332.*

59. ISACHNE R. Br.

ISACHNE R. Br. Prodr. Fl. Nov. Holl. 196. 1810.

Spikelets subglobose with two well-developed florets, the lower perfect or staminate, indurate and similar to the upper, or herbaceous and similar to the glumes, the rachilla segment between the florets evident; glumes equal, similar, shorter than the spikelet, exposing the florets; fruit plano-convex, indurate, the narrow margins of the lemma inrolled.

Herbaceous or sometimes woody perennials with flat blades and open or condensed panicles.

a. Low annual; culms slender, creeping; first floret similar to the glume in texture; fruit densely pubescent ..... 1. I. POLYGONOIDES
aa. Coarse perennial; culms cane-like, woody, erect or clambering; first floret similar to the second, both glabrous ..... 2. I. ARUNDINACEA

1. ISACHNE POLYGONOIDES (Lam.) Doell in Mart. Fl. Bras. 2^2:273. 1877.

Panicum polygonoides Lam. Encycl. 4:742. 1798.
Panicum trachyspermum Nees, Agrost. Bras. 212. 1829.
Isachne trachyspermum Nees in Seem. Bot. Voy. Herald 224. 1854.

Decumbent-spreading annual; culms slender, glabrous, ascending, rooting at the nodes, sometimes geniculate, freely branching, the erect shoots finally bearing

fascicled branchlets; sheaths much shorter than the internodes, papillose-hirsute to nearly glabrous, the margins usually ciliate; ligule ciliate; blades ovate-lanceolate, 1–5 cm. long, 5–15 mm. wide, very scabrous, papillose-hispid-ciliate at the rounded base; panicles 5–10 cm. long, nearly as wide, partly enclosed in the sheath, the branches and branchlets stiffly spreading or even reflexed, implicate, glandular-spotted; spikelets 1.5–1.7 mm. long, glabrous; first floret as long as the second glume, similar in texture, not indurate, glabrous; fruit about 1.2 mm. long, strongly plano-convex, densely pubescent.

Wet forests and savannas, grassy swamps, and along ditches and streams, Costa Rica and the West Indies to Peru and Brazil.

CHIRIQUÍ: Dolega, *Hitchcock 8333;* David, *Hitchcock 8375;* El Boquete, *Killip 4571.* COCLÉ: Aguadulce, *Pittier 4917.* COLÓN: Porto Bello, *Pittier 2454.* VERAGUAS: Soná, *Allen 1068.* CANAL ZONE: Gatún, *Hitchcock 9171;* Barro Colorado Island, *Kenoyer 120; Bailey & Bailey 645;* Juan Mina, *Bartlett & Lasser 16500;* Las Cruces Trail, *Killip 4189;* between Panamá and Corozal, *Hitchcock 9198;* between Fort Clayton and Corozal, *Standley 29133.* PANAMÁ: Las Sabanas, *Standley 25943;* Río Pescado, *Bartlett & Lasser 16599;* Matías Hernández, *Standley 28991;* Juan Díaz, *Killip 4060, 4170;* Río Tapia, *Standley 28224;* Río Tecúmen, *Standley 26569;* Nuevo San Francisco, *Standley 30754;* Chepo, *Pittier 4531; Hunter & Allen 15;* between Pacora and Chepo, *Woodson, Allen & Seibert 1655.*

2. ISACHNE ARUNDINACEA (Swartz) Griseb. Fl. Brit. W. Ind. 553. 1864.

Panicum arundinaceum Swartz, Prodr. Veg. Ind. Occ. 24. 1788.

Coarse woody perennial; culms cane-like, clambering, 1–6 m. long, freely branching, the branches drooping, elongate; sheaths of the main culm much shorter than the internodes, those of the branches overlapping, glabrous to papillose-hispid, especially on the margins; ligule ciliate, 2–3 mm. long; blades firm, 10–20 cm. long, 1–2 cm. wide, acuminate, scabrous, especially on the margins, and sometimes shortly hispid; panicles 6–12 cm. long, the branches stiffly ascending or finally spreading, naked toward the base; spikelets 1.5–1.7 mm. long, clustered at the ends of the branches; glumes equal, similar, shorter than the fruit, glabrous or sparsely hispid; fertile florets similar in texture, glabrous on the back, sparsely pilose at the base, the first elliptic, acutish, the second smaller, oblong.

CHIRIQUÍ: El Boquete, *Hitchcock 8277.* COCLÉ: El Valle, *Allen 119.*

60. OPLISMENUS Beauv.

OPLISMENUS Beauv. Fl. Owar. 2:14. *pl. 68. f. 1.* 1810.

Spikelets subsessile, solitary or in pairs, crowded, in two rows on one side of a slender rachis; glumes nearly equal, more than half as long as the sterile lemma, 3- to 5-nerved, the first long-awned, the second short-awned; sterile lemma longer than the fruit, mucronate or short-awned, enclosing a hyaline palea; fruit elliptic, acute, indurate, smooth and shining, the margins firm, enclosing the palea.

Creeping, branching annuals or perennials with thin lanceolate or lanceolate-acuminate blades and inflorescences composed of few to several short, stiffly ascending or spreading racemes approximate or rather distant on a main axis.

a. Plants annual; rachis of racemes densely hairy; awns antrorsely scabrous ..... 1. O. BURMANNI
aa. Plants perennial; rachis of racemes scabrous; awns smooth ..... 2. O. HIRTELLUS

1. OPLISMENUS BURMANNI (Retz.) Beauv. Ess. Agrost. 54. 1812.

Panicum burmanni Retz. Obs. Bot. 3:10. 1783.
Orthopogon burmanni Trin. Fund. Agrost. 181. 1820.
Oplismenus affinis Schult. Mant. 2:273. 1824.
Oplismenus affinis Presl, Rel. Haenk. 1:323. 1830.
Oplismenus cristatus Presl, Rel. Haenk. 1:323. 1830.
Oplismenus preslii Kunth, Rév. Gram. 1: Suppl. X. 1830.
Panicum schultesii Steud. Nom. Bot. ed. 2. 2:263. 1841.
Oplismenus humboldtianus var. *muticus* Fourn. Mex. Pl. 2:37. 1886.
Oplismenus humboldtianus var. *nudicaulis* Vasey, Contr. U. S. Nat. Herb. 1:363. 1893.

Low creeping annual; culms slender, 15–50 cm. long, nearly simple to freely branching, with short internodes, decumbent or prostrate-spreading with ascending branches; sheaths usually much shorter than the internodes, sparsely to densely papillose-hispid, the margins densely ciliate; blades broadly lanceolate-elliptic, often asymmetrical, acuminate, 1.5–5 cm. long, 5–15 mm. wide, glabrous to pubescent or hirsute, the margins scabrous; inflorescence 1–6 cm. long, frequently long-exserted, of 3–6, rarely 10, short approximate racemes, the axis densely villous, flexuous; racemes 0.5–2 cm. long, ascending, the rachis densely villous; spikelets 3 mm. long, usually densely villous; glumes minutely lobed, about 2 mm. long, the second a little longer than the first; awns antrorsely scabrous, that of the first glume 10–14 mm. long, of the second 3–8 mm. long; sterile lemma minutely lobed, awnless, or with an awn 1–3 mm. long; fruit 2 mm. long, narrowly elliptic, acute.

Called Pajita de ratón in Panama.

Moist forests, thickets, and savannas; a common weed in fields and waste places, Mexico and the West Indies to Brazil; Tropics of both hemispheres.

BOCAS DEL TORO: Bocas del Toro, *Carleton 18;* Laguna de Chiriquí, *Hart 74;* Water Valley, *von Wedel 1494;* Quebrada Nigua, *von Wedel 2739;* Changuinola Valley, *Stark 52;* Almirante, *Cooper 98.* CHIRIQUÍ: El Boquete, *Hitchcock 8304;* San Felix, *Pittier 5205.* CANAL ZONE: Chagres, *Fendler 363;* Gamboa, *Standley 28512;* Valley of Masambí, *Maxon 4688;* Empire, *Hitchcock 7951;* Culebra, *Hitchcock 9165; Pittier 2086;* Ancón Hill, *Killip 4244;* Sosa Hill, *Standley 25248;* Balboa, *Standley 25451;* Balboa Heights, *Killip 4180.* PANAMÁ: Matías Hernández, *Pittier 6822;* Panamá, *Killip 4191;* Río Tapia, *Standley 28050;* Río Tecúmen, *Standley 26538;* Chepo, *Hunter & Allen 13;* Taboga Island, *Standley 27080; McBride 2806; Allen 1301.* WITHOUT LOCALITY: *Haenke* (TYPE).

2. OPLISMENUS HIRTELLUS (L.) Beauv. Ess. Agrost. 54, 168. 1812.

Panicum hirtellum L. Syst. Nat. ed. 10. 2:870. 1759.
Orthopogon cubensis Spreng. Syst. Veg. 1:307. 1825.
Echinochloa cubensis Schult. Mant. 3 (Add. 1):596. [1827].
Oplismenus cubensis Kunth, Rév. Gram. 1:45. 1829.
Panicum cubense Steud. Nom. Bot. ed. 2. 2:255. 1841.
Oplismenus chondrosioides Fourn. Mex. Pl. 2:39. 1886.

Widely spreading perennial; culms with short internodes, freely branching, decumbent-spreading and rooting at the nodes, the erect or ascending branches 20–70 cm. long; sheaths glabrous to densely papillose-hispid, the margins ciliate,

the lower ones usually much shorter than the internodes, the upper frequently overlapping; blades 4–10 cm., rarely 15 cm., long, 1–2 cm. wide, acuminate, usually asymmetric, rather thin, glabrous or sometimes pubescent, the margins scabrous; inflorescence 5–15 cm. long, of 3–7 stiffly ascending, rather distant racemes 1–2 cm., rarely 3 cm., long, the rachis more or less papillose-hispid, especially at the base; spikelets 3–3.5 mm. long, glabrous to sparsely pilose; glumes about equal, 2 mm. long; awns glabrous, usually purplish, that of the first glume 5–10 cm. long, that of the second about 2 mm. long; sterile lemma acuminate; fruit 3 mm. long, elliptic, acute, minutely striate.

Moist forests, thickets, and banks of rivers and streams, Mexico and the West Indies to Argentina.

BOCAS DEL TORO: Laguna de Chiriquí, *Hart 83;* Old Bank Island, *von Wedel 2073.* CHIRIQUÍ: Volcán de Chiriquí, *Hitchcock 8194;* El Boquete, *Hitchcock 8309, 8312.* COCLÉ: Río Mata Ahogado, *Allen 129.* CANAL ZONE: Fort Sherman, *Standley 31046;* Gatún, *Hitchcock 9184;* Frijoles, *Standley 27569;* Barro Colorado Island, *Standley 31251;* Darién Station, *Standley 31636; Bailey & Bailey 113;* Las Cascadas Plantation, *Standley 25712, 29498;* Culebra, *Standley 26010;* East Paraíso, *Standley 29929;* Ancón Hill, *Killip 4206;* Balboa, *Standley 29263.* PANAMÁ: Campana, *Allen 1319.*

61. ECHINOCHLOA Beauv.

ECHINOCHLOA Beauv. Ess. Agrost. 53. *pl. 11. f. 2.* 1812.

Spikelets subsessile, solitary or in pairs in two rows on one side of a slender rachis, scabrous and sparsely to prominently hispid; first glume broad, triangular, acute, 3-nerved; second glume and sterile lemma nearly equal, 5- to 7-nerved, the lateral nerves approximate, mucronate, or the glume short-awned, the lemma long-awned, sometimes enclosing a palea and staminate flower; fruit plano-convex, elliptic, minutely crested, indurate, shining, minutely striate, the margins of the lemma not inrolled, the tip of the palea not enclosed.

Slender to coarse annuals or perennials with compressed sheaths, linear blades, and few to many densely flowered racemes, distant or approximate on a main axis.

a. Ligule a dense line of long yellowish hairs; plants perennial ..... 1. E. SPECTABILIS
aa. Ligule wanting; plants annual.
  b. Spikelets 3 mm. long, strongly hispid, the sterile lemma with an awn 1–10 mm. long; culms coarse, erect or decumbent at the base ..... 2. E. CRUSPAVONIS
  bb. Spikelets 2–2.5 mm. long, scabrous, sparsely and inconspicuously hispid, the second glume and sterile lemma mucronate only; culms slender, erect to prostrate-spreading ..... 3. E. COLONUM

1. ECHINOCHLOA SPECTABILIS (Nees) Link, Hort. Berol. 2:209. 1833.

Panicum spectabile Nees in Trin. Gram. Pan. 138. 1826.

Coarse aquatic perennial; culms 1–2 m. high from a long creeping rooting base, the nodes usually densely bearded with yellowish hairs; sheaths glabrous to papillose-hispid, the margins papillose-hispid-ciliate; ligule a dense line of stiff yellowish hairs about 4 mm. long; blades elongate, acuminate to attenuate, 1–3 cm. wide, the margins very scabrous, sparsely papillose or ciliate at the base; inflorescence 10–30 cm. long, erect, dense, the axis very scabrous and sparsely hispid;

racemes usually crowded, 3–6 cm. long, ascending to spreading, the rachis hispid, especially at the base; spikelets about 5 mm. long, very short-pedicelled, coarsely hispid; first glume broad, acute, or short-awned, two-thirds to three-fourths as long as the spikelet; second glume acuminate; sterile lemma containing a staminate flower, the awn 2–10 mm. long; fruit 4–5 mm. long including a pointed beak about 0.5 mm. long.

Swamps and ditches near the coast, sometimes in water several feet deep. Mexico and the West Indies to Argentina.

SAN BLAS: near Puerto Obaldía, *Pittier 4383*.

2. ECHINOCHLOA CRUSPAVONIS (H.B.K.) Schult. Mant. 2:269. 1824.

Oplismenus cruspavonis H.B.K. Nov. Gen. & Sp. 1:108. 1815.
Panicum sabulicola Nees, Agrost. Bras. 258. 1829.
Panicum cruspavonis Nees, Agrost. Bras. 259. 1829.
Panicum aristatum Macfad. Bot. Misc. (Hook.) 2:115. 1831.
Oplismenus jamaicensis Kunth, Enum. Pl. 1:147. 1833.
Panicum jamaicensis Steud. Nom. Bot. ed. 2. 2:257. 1841.
Panicum crusgalli var. *sabulicola* Doell in Mart. Fl. Bras. 2^2:142. 1877.
Oplismenus angustifolius Fourn. Mex. Pl. 2:40. 1886.
Echinochloa sabulicola Hitchc. Contr. U. S. Nat. Herb. 17:257. 1913.
Echinochloa crusgalli cruspavonis Hitchc. Contr. U. S. Nat. Herb. 22:148. 1920.
Echinochloa zelayensis var. *subaristata* Wiegand, Rhodora 23:54. 1921.

Annual; culms soft and somewhat succulent but rather coarse, erect or decumbent at the base, compressed, glabrous, shiny, 0.5–1.5 m. high; lower sheaths longer, the upper shorter than the internodes, compressed, keeled, rather loose, glabrous; ligule wanting; blades elongate, acuminate, 5–15 mm. wide, the margins scabrous; panicles 10–20 cm. long, nodding, the branches densely flowered, the lower ones rather distant, the upper ones crowded, ascending or appressed; spikelets 3 mm. long, rather narrow, sparsely hispid on the nerves, hispidulous between the nerves; first glume broad, triangular, acute; second glume and sterile lemma equal, as long as or a little shorter than the fruit, 5- to 7-nerved, the glume acuminate or short-awned, the lemma with an awn 1–10 mm. long, sometimes with a palea about as long as the lemma; fruit elliptic, smooth and shining, abruptly acuminate-pointed.

Along ditches and in moist or wet ground, tropical and subtropical regions of both hemispheres; southern United States and the West Indies to Bolivia and Argentina.

CANAL ZONE: Chagres, *Fendler 365;* between Miraflores and Pedro Miguel, *Pittier 2508;* Victoria Fill, *Allen 1707;* between Pedro Miguel and Corozal, *Hitchcock 7958;* Corozal, *Standley 27400;* Ancón, *Killip 4107; Bro. Celestine 18;* Balboa, *Hitchcock 7999; Standley 30876.*

3. ECHINOCHLOA COLONUM (L.) Link, Hort. Berol. 2:209. 1833.

Panicum colonum L. Syst. Nat. ed. 10. 2:870. 1759.
Milium colonum Moench, Meth. Pl. 202. 1794.
Oplismenus colonum H.B.K. Nov. Gen. & Sp. 1:108. 1815.
Panicum zonale Guss. Fl. Sic. Prodr. 1:62. 1827.
Oplismenus repens Presl, Rel. Haenk. 1:321. 1830.
Panicum prorepens Steud. Syn. Pl. Glum. 1:46. 1854.

Oplismenus crusgalli var. *colonum* Coss. & Dur. Expl. Sci. Alger. 2:28. 1854.
Panicum crusgalli var. *colonum* Coss. ex Richt. Pl. Eur. 1:26. 1890.
Panicum colonum var. *zonale* L. H. Dewey, Contr. U. S. Nat. Herb. 2:502. 1894.
Echinochloa colonum var. *zonalis* Woot. & Standl. N. Mex. Coll. Agr. Bull. 81:45. 1912.

Annual; culms slender, prostrate to erect, freely branching at the base and lower nodes, 15–70 cm. long; sheaths glabrous; ligule wanting; blades soft and rather thin, lax, 5–10 cm., rarely 15 cm., long, 3–6 mm., rarely 10 mm., wide, glabrous, the margins sparsely scabrous; inflorescence 3–10 cm. long, rarely longer; racemes few to several, ascending, the lower ones 1–2 cm. distant, 1–3 cm. long; spikelets 2–2.5 mm. long, scabrous or finely hispid; first glume triangular, acute, about one-third as long as the spikelet; second glume and sterile lemma equal, pointed, awnless; fruit 1.8 mm. long, elliptic, acute.

CANAL ZONE: Frijoles, *Standley 27648, 31475;* New Frijoles, *Pittier 6837;* between Frijoles and Monte Lirio, *Killip 12176;* Darién Station, *Standley 31537;* Gamboa, *Standley 28528;* Las Cascadas Plantation, *Standley 29552;* Empire, *Pittier 3720, 3723;* Victoria Fill, *Allen 1717;* between Corozal and Ancón, *Pittier 6770;* Culebra, *Hitchcock 7922;* Summit, *Standley 26903, 30088;* between Miraflores and Pedro Miguel, *Pittier 2505;* between Corozal and Ancón, *Pittier 2184;* Ancón, *Killip 4111;* Balboa, *Standley 25635, 30893.* PANAMÁ: Panamá, *Standley 27673;* Río Tecúmen, *Standley 29488.*

62. SETARIA Beauv.

SETARIA Beauv. Ess. Agrost. 51. *pl. 13. f. 3.* 1812. (Conserved).
Chaetochloa Scribn. U. S. Dept. Agr. Div. Agrost. Bull. 4:38. 1897.

Spikelets subtended by one or more bristles, the spikelets deciduous, the bristles persistent; first glume broad, less than half as long as the spikelet, 3- to 5-nerved; second glume and sterile lemma nearly equal, slightly longer than the fruit, or the glume sometimes shorter; fruit indurate, smooth or rugose.

Annuals or perennials with flat, sometimes plaited blades, and spike-like, bristly panicles, or the panicles open with the spikelets rather crowded along the branches, some of the branches or branchlets reduced to sterile bristles around the spikelets.

a. Blades plaited, narrowly elliptic; bristles usually below only some of the spikelets.
  b. Plants annual; panicles 7–20 cm. long, narrow, the branches short, appressed, floriferous to the base; bristles 5–10 mm. long; spikelets 2.5 mm. long ..... 1. S. BARBATA
  bb. Plants perennial; panicles 40–70 cm. long, the lower branches distant, compound, ascending to spreading, as much as 25 cm. long ..... 2. S. PANICULIFERA
aa. Blades not plaited; bristles below all the spikelets.
  b. Bristles more or less retrorsely scabrous.
    c. Plants perennial; culms erect, densely tufted; spikelets subspherical, appearing inflated ..... 3. S. TENAX
    cc. Plants annual; culms decumbent-spreading or low-clambering.
      d. Panicles 3–8 cm. long, about 5 mm. thick, dense; bristles commonly about 3 mm. long, retrorsely scabrous only at the tip, not implicate ..... 4. S. SCANDENS
      dd. Panicles as much as 15 cm. long, about 1 cm. thick; bristles 5–10 mm. long, prominently retrorsely scabrous above, somewhat flexuous, becoming implicate ..... 5. S. TENACISSIMA
  bb. Bristles antrorsely scabrous only.
    c. Panicles 2–10 cm. long, dense, spike-like, the axis pubescent and

sparsely villous; bristles below each spikelet more than 5; culms slender, 20–100 cm. long ..... 6. S. GENICULATA

cc. Panicles 15–30 cm. long, as much as 6 cm. wide, rather loose, the axis densely villous; bristles below each spikelet 1 or 2, 1–2 cm. long; culms coarse, as much as 2 m. long ..... 7. S. VULPISETA

1. SETARIA BARBATA (Lam.) Kunth, Rév. Gram. 1:47. 1829.

Panicum barbatum Lam. Tabl. Encycl. 1:171. 1791.
Panicum costatum Roxb. Fl. Ind. ed. Carey 1:314. 1820.
Panicum viaticum Salzm. ex Doell, in Mart. Fl. Bras. 2[2]:155. 1877.
Chamaeraphis viatica Kuntze, Rev. Gen. Pl. 2:770. 1891.
Chamaeraphis costata Kuntze, Rev. Gen. Pl. 2:771. 1891.
Chaetochloa barbata Hitchc. & Chase, Contr. U. S. Nat. Herb. 18:348. 1917.

Annual; culms erect or usually decumbent-spreading and rooting at the lower nodes, 25 cm. in depauperate plants, to as much as 2 m. long, branching, usually pubescent or villous below the densely pubescent nodes; sheaths compressed, glabrous or papillose-hispid; ligule 1 mm. long, densely ciliate; blades elliptic, acuminate, narrowed at the base, scabrous and papillose-hispid, thin, plaited, as much as 30 cm. long, 3 cm. wide, in depauperate specimens 5–10 cm. long, 5–15 mm. wide, often obscurely plaited; panicles commonly 7–10 cm., or as much as 20 cm. long, the axis scabrous and sparsely villous, the short branches approximate, ascending to spreading, densely flowered to the base; spikelets about 2.5 mm. long, usually in pairs along the raceme-like branches, the bristles 5–10 mm. long; first glume obtuse or subacute, one-third as long as the spikelet, the second acute, 7-nerved, two-thirds as long as the spikelet; fruit elliptic, acute, strongly transversely rugose.

Introduced from tropical Asia; Florida, West Indies, Panama, and Brazil.

CANAL ZONE: Culebra, *Standley 25954*.

2. SETARIA PANICULIFERA (Steud.) Fourn. Mex. Pl. 2:42. 1886.

Panicum sulcatum Aubl. Pl. Guian. 1:50. 1775. Not *P. sulcatum* Bertol., 1820.
Panicum paniculiferum Steud. Syn. Pl. Glum. 1:54. 1854.
Setaria effusa Fourn. Mex. Pl. 2:42. 1886.
Chaetochloa sulcata Hitchc. Contr. U. S. Nat. Herb. 17:260. 1913.
Setaria sulcata A. Camus, Bull. Mus. Hist. Nat. 30: 108. 1924. Not S. *sulcata* Raddi, 1823.

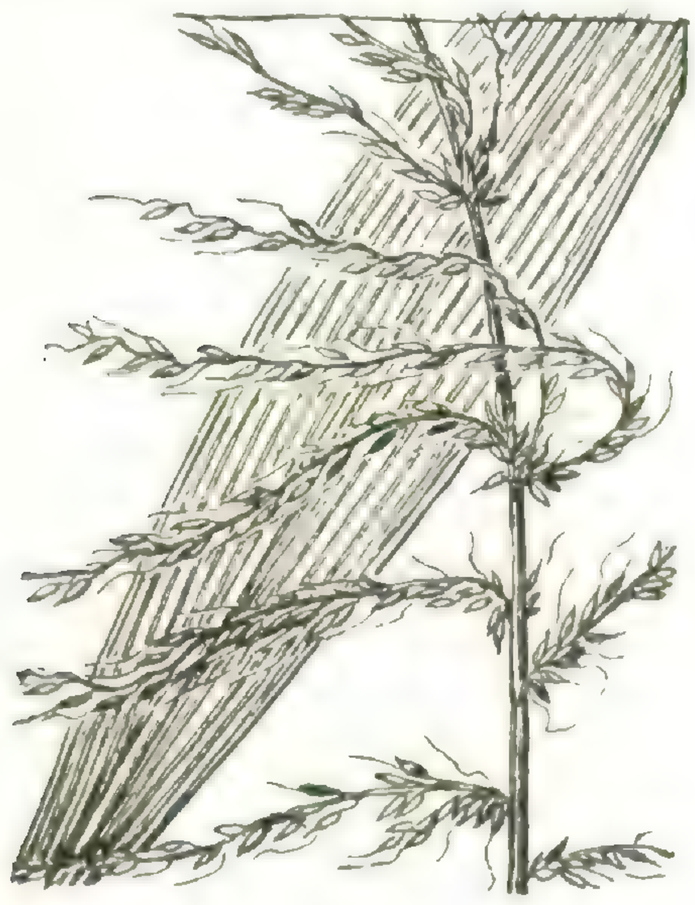

Fig. 27
Setaria paniculifera

Robust perennial; culms erect, 1.5–4 m. high; sheaths keeled toward the summit, papillose or papillose-hispid, especially along the margins and on the collar; blades conspicuously plicate, 0.5–1 m. long, 3–5 cm., or even 10 cm., wide, scabrous, acuminate, narrowed toward the base to the width of the sheath, sometimes petiole-like; panicles narrow or finally loose and open, 40–70 cm. long, the lower branches distant, compound, loosely to rather densely flowered, ascending to

spreading, as much as 25 cm. long, the upper shorter, approximate, nearly simple; spikelets 3 mm. long, pointed, the bristles about 15 mm. long; first glume obtuse, 3- to 5-nerved, about half as long as the spikelet, the second acute, 5- to 7-nerved, two-thirds as long as the spikelet; fruit narrow, acute, finely transversely rugose.

Thickets, river banks and swamps, Mexico and the West Indies to Colombia and Venezuela.

BOCAS DEL TORO: Changuinola Valley, *Dunlap 245.* CANAL ZONE: Barro Colorado Island, *Bailey & Bailey 382;* Gamboa, *Pittier 6800;* Summit, *D. H. Popenoe 25;* Bohio, *Hitchcock 8391;* Ancón, *Killip 4025;* Ancón Hill, *Killip 4205;* Culebra, *Hitchcock 7935, 8122.* PANAMÁ: Chepo River, *Killip 4114.* DARIÉN: Yapé, *Allen 859.*

3. SETARIA TENAX (L. Rich.) Desv. Opusc. 78. 1831.

Panicum tenax L. Rich. Act. Soc. Hist. Nat. Paris 1:106. 1792.
Panicum impressum Nees, Agrost. Bras. 247. 1829.
Setaria impressa Kunth, Rév. Gram. 1: Suppl. XII. 1830.
Panicum sphaerocarpum Salzm. ex Steud. Syn. Pl. Glum. 1:51. 1854. Not *P. sphaerocarpon* Ell., 1816.
Panicum amphibolum Steud. Syn. Pl. Glum. 1:51. 1854.
Setaria biconvexa Griseb. Fl. Brit. W. Ind. 555. 1864.
Chaetochloa salzmanniana Hitchc. Contr. U. S. Nat. Herb. 17:265. 1913.
Chaetochloa impressa Hitchc. & Chase, Contr. U. S. Nat. Herb. 18:350. 1917.
Setaria sphaerocarpa F. T. Hubb. Contr. Gray Herb. (n. s.) 52:60. 1917.
Chaetochloa tenax Hitchc. Contr. U. S. Nat. Herb. 22^3:176. 1920.

Densely tufted perennial; culms 1–1.5 m. high, stiffly erect, scabrous below the panicle; sheaths compressed, keeled, hirsute, hispid on the collar, all much longer than the internodes; ligule densely ciliate, about 2 mm. long; blades as much as 35 cm. long, 2 cm. wide, long-acuminate, narrowed toward the base, scabrous, especially on the margins; panicles 15–30 cm. long, erect, densely spike-like or rather loose, narrowed above, the axis scabrous and rather densely villous, the branches appressed or stiffly ascending, the lower ones 1.5–3 cm. long; bristles 1 or 2 below each spikelet, 1–2 cm. long, antrorsely and retrorsely barbed; spikelets 2–2.5 mm. long, subspherical, appearing inflated; first glume broad, obtuse or subacute, apiculate, 5-nerved; second glume two-thirds as long as the spikelet, obtuse; sterile lemma as long as the fruit, the palea well developed; fruit turgid, minutely crested, finely cross-wrinkled.

PANAMÁ: Taboga Island, *Hitchcock 8085; Killip 4158; Bro. Celestine 87.*

4. SETARIA SCANDENS Schrad. ex Schult. Mant. 2:279. 1824.

Panicum scandens Trin. Gram. Pan. 166. 1826.
Panicum trinii Kunth, Enum. Pl. 1:151. 1833.
Panicum scandens α. vulgare Doell in Mart. Fl. Bras. 2^2:171. 1877.
Panicum scandens γ. longisetum Doell in Mart. Fl. Bras. 2^2:171. 1877.
Chaetochloa scandens Scribn. in Donn. Smith, Enum. Pl. Guat. 5:91. 1899.

Freely branching annual; culms slender, erect or geniculate-spreading, glabrous, the nodes often appressed-pilose, 25–80 cm. high; sheaths compressed, keeled, glabrous to pilose, the margins papillose-ciliate; ligule densely ciliate, about 1 mm. long; blades 5–15 cm. long, 4–10 mm. wide, acuminate, tapering to a narrow

base, scabrous and more or less pilose; panicles dense, spike-like, cylindrical, green or often purple, sometimes interrupted at the base, 3–8 cm. long, the axis scabrous or pubescent and also long-pilose, the branches very short; bristles at least partly retrorsely scabrous, especially at the tip, 3–6 mm. long, 1–3 below each spikelet; spikelets 1.5–1.7 mm. long, rather turgid; first glume about half as long as the spikelet, broad, acute or subobtuse, 3-nerved; second glume and sterile lemma nearly equal, 5-nerved, covering the fruit; fruit strongly plano-convex or subhemispheric, transversely rugose.

Open ground, fields, and waste places, West Indies; Guatemala to Paraguay.

PANAMÁ: Alhajuela, *Pittier 3463*.

5. SETARIA TENACISSIMA Schrad. ex Schult. Mant. 2:279. 1824.

Panicum tenacissimum Nees, Agrost. Bras. 238. 1829.
Chaetochloa tenacissima Hitchc. & Chase, Contr. U. S. Nat. Herb. 18:352. 1917.

Annual; culms simple to rather freely branching, erect or leaning or clambering over vegetation, 30 cm. to as much as 2 m. long, glabrous, sometimes scabrous below the panicle; sheaths compressed, keeled, more or less antrorsely scabrous or nearly glabrous, the margins sometimes ciliate toward the summit; ligule densely ciliate, about 0.5 mm. long; blades 6–20 cm. long, 4–10 mm., or sometimes 15 mm., wide, long-acuminate, firm, very scabrous, especially on the margins, and also pilose; panicles 5–15 cm. long, more or less flexuous, green or usually tinged with purple, the axis densely pubescent and sparsely pilose; bristles one below each spikelet, 5–10 mm. long, prominently retrorsely scabrous above, antrorsely below, flexuous, becoming implicate and tangled; spikelets 1.5 mm. long, usually purple; first glume half as long as the spikelet, 3-nerved, the second glume and sterile lemma equal, 5-nerved, covering the finely transversely rugose fruit.

River banks and brushy slopes, West Indies; Guatemala to Brazil.

CHIRIQUÍ: El Boquete, *Hitchcock 8291;* Bajo Boquete, *Killip 4564.*

6. SETARIA GENICULATA (Lam.) Beauv. Ess. Agrost. 51:178. 1812.

Panicum geniculatum Lam. Encycl. 4:727. 1798.
Setaria gracilis H.B.K. Nov. Gen. & Sp. 1:109. 1815.
Panicum imberbe Poir. in Lam. Encycl. Suppl. 4:272. 1816.
Panicum flavum Nees, Agrost. Bras. 238. 1829.
Chaetochloa imberbis Scribn. U. S. Dept. Agr. Div. Agrost. Bull. 4:39. 1897.
Chaetochloa imberbis geniculata Scribn. & Merr. U. S. Dept. Agr. Div. Agrost. Bull. 21:12. 1900.
Chaetochloa geniculata Millsp. & Chase, Field Mus. Bot. 3:37. 1903.
For complete synonymy see Contr. U. S. Nat. Herb. 22^3:168-171. 1920; Hitchcock, U. S. Dept. Agr. Misc. Publ. 200. 1935.

Densely tufted perennial; culms erect or geniculate-spreading, from short knotty rhizomes, 20 cm. to more than 1 m. long, branching at the lower nodes, glabrous; sheaths keeled, glabrous or scabrous toward the summit; ligule 0.5–1 mm. long, densely minutely ciliate; blades mostly 5–15 cm. long, 4–6 mm. wide, flat, acuminate, scabrous, often sparsely villous on the upper surface toward the

base; panicles dense, narrow, spike-like, yellow, purple, tawny, or greenish, mostly 2–6 cm. long, or as much as 10 cm. long on robust plants, the axis densely pubescent and sparsely villous; bristles below each spikelet 5 or more, commonly 5–10 mm. long, sometimes not longer than the spikelets; spikelets 2–2.5 mm., or even 3 mm., long, ovoid; first glume one-third as long as the spikelet, 3-nerved; second half to two-thirds as long as the spikelet, 5-nerved; sterile lemma acute, as long as the fruit, 5- to 7-nerved, the palea well developed, sometimes with a staminate flower; fruit strongly transversely rugose.

Open ground, cultivated soil, and waste places, United States and the West Indies to Argentina; also in the Old World.

BOCAS DEL TORO: *Carleton 30;* Laguna de Chiriquí, *von Wedel 1125;* Isla Colón, *von Wedel 2837.* CHIRIQUÍ: El Boquete, *Hitchcock 8171, 8285; Pittier 3042; Woodson & Schery 717, 762;* Cerro Vaca, *Pittier 5344.* CANAL ZONE: Mount Hope Cemetery, *Standley 28806;* Gatún, *Hitchcock 9173;* New Frijoles, *Pittier 6840;* Barro Colorado Island, *Bailey & Bailey 630;* Gamboa, *Pittier 4792;* Empire, *Pittier 3719;* Culebra, *Hitchcock 7921; Pittier 4444;* Corozal, *Killip 4104, 4251;* Ancón, *Piper 5230; Killip 4021;* Ancón Hill, *Killip 4016; Standley 26359.* PANAMÁ: Matías Hernández, *Pittier 6759;* Arraiján, *Woodson, Allen & Seibert 1390;* Chepo, *Hunter & Allen 69;* Taboga Island, *Hitchcock 8062.*

7. SETARIA VULPISETA (Lam.) Roem. & Schult. Syst. Veg. 2:495. 1817.

Panicum vulpisetum Lam. Encycl. 4:735. 1798.
Setaria composita H.B.K. Nov. Gen. & Sp. 1:111. 1815.
Setaria polystachya Schrad. ex Schult. Mant. 2:277. 1824.
Panicum compositum Nees, Agrost. Bras. 244. 1829.
Panicum macrourum Trin. Mém. Acad. St. Pétersb. VI. Sci. Nat. 1:227. 1834.
Panicum amplifolium Steud. Syn. Pl. Glum. 1:53. 1854.
Panicum subsphaerocarpum Salzm. ex Schlecht. Linnaea 31:483. 1862.
Chamaeraphis setosa var. *vulpiseta* Kuntze, Rev. Gen. Pl. 2:769. 1891.
Chamaeraphis composita Kuntze ex Beal, Grasses N. Amer. 2:154. 1896.
Chaetochloa composita Scribn. U. S. Dept. Agr. Div. Agrost. Bull. 4:39. 1897.
Chaetochloa vulpiseta Hitchc. & Chase, Contr. U. S. Nat. Herb. 18:350. 1917.

Coarse perennial; culms in large tufts, erect or geniculate and rooting at the lower nodes, branching, as much as 2 m. high, glabrous; sheaths usually much longer than the internodes, compressed, keeled, glabrous to rather densely hirsute, with a dense hispid line on the collar; ligule densely hispid, 2 mm. long; blades as much as 50 cm. long, 2–3.5 cm. wide, acuminate, narrowed to a usually rather long, often petiolate base, scabrous, especially on the lower surface, the margins sharply scabrous; panicles 15–30 cm. long, as much as 6 cm. wide including the bristles, somewhat narrowed toward the apex, the axis densely villous, the branches slender, compound, crowded, ascending or spreading; bristles 1 to 2 below each spikelet, 1–2 cm. long, yellowish or brownish; spikelets 2–2.5 mm. long; first glume obtuse or acutish, 3-nerved, about half as long as the spikelet, the second obtuse, 7-nerved, about two-thirds as long as the spikelet; sterile lemma as long as the spikelet, 5-nerved; fruit rather strongly transversely rugose, acute, minutely crested.

Open ground, moist thickets and brushy slopes, southern Mexico and the West Indies to Peru and Argentina.

Common, often growing in colonies.

BOCAS DEL TORO: Changuinola Valley, *Dunlap 200; Stork 271;* Water Valley, *von Wedel 1615.* CANAL ZONE: Toro Point, *Hitchcock 8046;* Fort Kobe, *Allen 2025;* Río Pequení, *Woodson, Allen & Seibert 1627;* Gatún River Valley, *Pittier 6850;* Frijoles, *Standley 27660;* Barro Colorado Island, *Standley 41172; Kenoyer 111; Bailey & Bailey 330;* Gorgona, *Maxon 4734;* Obispo, *Standley 31734;* between Las Cascadas and Bas Obispo, *Pittier 3744;* Culebra, *Hitchcock 7898, 7906, 7926, 8026; Pittier 2121;* Summit, *Standley 26958, 30058;* Miraflores, *Greenman & Greenman 5180;* Red Tank to Pueblo Nuevo, *Piper 5228;* between Fort Clayton and Corozal, *Standley 29145;* Corozal, *Killip 4023;* Balboa, *Standley 26059, 29310.* PANAMÁ: Taboga Island, *Hitchcock 8093; Standley 27927.* SAN BLAS: Puerto Obaldía, *Pittier 4332.*

63. PENNISETUM L. Rich.

PENNISETUM L. Rich. in Pers. Syn. Pl. 1:72. 1805.

Gymnothrix Beauv. Ess. Agrost. 59. *pl. 13. f. 6.* 1812.

Spikelets solitary or in groups of 2 or 3, the groups enclosed in a fascicle of bristles, these united only at the base, often plumose, falling attached to the spikelets; first glume much shorter than the spikelet, sometimes minute or wanting, thin, 1-nerved; second glume and sterile lemma subequal, or the glume a little shorter, 5-nerved; fruit subindurate, smooth and shining, the margins of the lemma thin and flat.

Annuals or perennials, sometimes rather woody, with flat blades and dense spike-like panicles.

a. Bristles plumose; spikelets 3.2–4 mm. long ..... 1. P. SETOSUM
aa. Bristles not plumose; spikelets 6–7 mm. long ..... 2. P. COMPLANATUM

1. PENNISETUM SETOSUM (Swartz) L. Rich. in Pers. Syn. Pl. 1:72. 1805.

Cenchrus setosus Swartz, Prodr. Veg. Ind. Occ. 26. 1788.
Panicum cenchroides L. Rich. Act. Soc. Hist. Nat. Paris 1:106. 1792.
Pennisetum purpurascens H.B.K. Nov. Gen. & Sp. 1:113. 1815.
Pennisetum uniflorum H.B.K. Nov. Gen. & Sp. 1:114. *pl. 34.* 1815.
Panicum densispica Poir. in Lam. Encycl. Suppl. 4:273. 1816.
Panicum triticoides Poir. in Lam. Encycl. Suppl. 4:274. 1816.
Setaria cenchroides Roem. & Schult. Syst. Veg. 2:495. 1817.
Pennisetum triticoides Roem. & Schult. Syst. Veg. 2:877. 1817.
Gymnothrix geniculata Schult. Mant. 2:284. 1824.
Pennisetum alopecuroides Desv. ex Hamilt. Prodr. Pl. Ind. Occ. 11. 1825.
Pennisetum richardi Kunth, Rév. Gram. 1:49. 1829.
Pennisetum sieberi Kunth, Rév. Gram. 1:50. 1829.
Pennisetum hirsutum Nees, Agrost. Bras. 284. 1829.
Pennisetum pallidum Nees, Agrost. Bras. 285. 1829.
Pennisetum flavescens Presl, Rel. Haenk. 1:316. 1830.
Pennisetum dasistachyum Desv. Opusc. 76. 1831.
Pennisetum hamiltonii Steud. Nom. Bot. ed. 2. 2:297. 1841.
Pennisetum nicaraguense Fourn. Bull. Soc. Bot. France II. 27:293. 1880.
Pennisetum indicum var. *purpurascens* Kuntze, Rev. Gen. Pl. 2:787. 1891.

Coarse perennial in large loose clumps; culms erect or ascending, sometimes geniculate at the lower nodes, bearing 1 to several branches from the lower and middle nodes, glabrous; sheaths much shorter than the internodes, usually glabrous or occasionally papillose-hirsute, sometimes ciliate on the margins near the summit; ligule membranaceous-ciliate, 2–3 mm. long; blades 10–40 cm. long, 4–18 mm. wide, long-acuminate, scabrous to densely papillose-hirsute, papillose-hispid on the margins near the base; panicles 10–25 cm. long, dense, usually somewhat nodding, pale yellow to purple or brown, the axis slender, obscurely scabrous; fascicles ascending, reflexed at maturity, containing 1 spikelet; bristles appressed to the spikelet, unequal, the outer ones slender, shorter than the spikelet, the inner ones stouter, as much as 12 mm. long, densely plumose below, scabrous above; spikelets 3.2–4 mm. long, sessile; first glume minute or obsolete; second glume longer than the sterile lemma, acuminate or obscurely lobed; sterile lemma truncate at the apex, the palea well developed and sometimes containing a staminate flower; fruit indurate, 2–3 mm. long, smooth and shining, the lemma and palea ciliate at the apex.

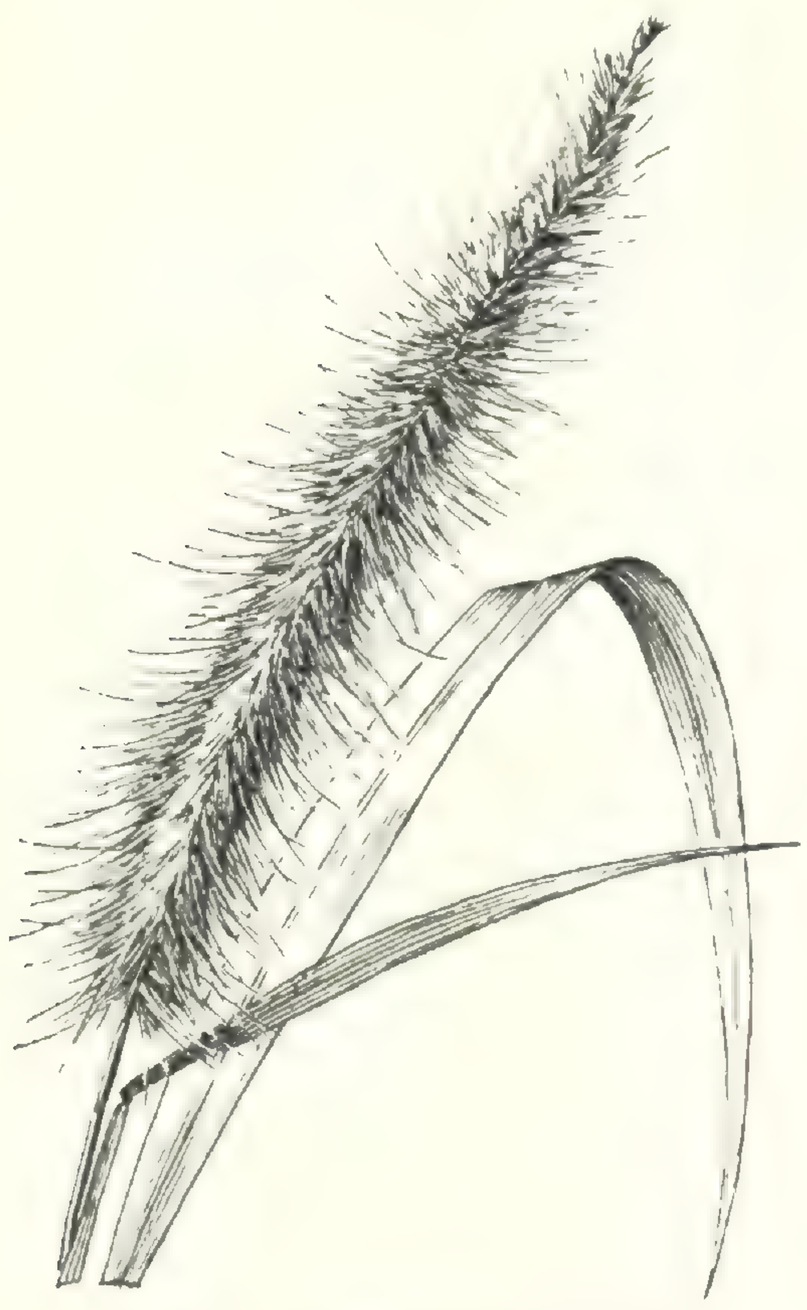

Fig. 28. *Pennisetum setosum*

Savannas and open or brushy slopes, West Indies; Florida and southern Mexico to Bolivia and Brazil.

CANAL ZONE: Sosa Hill, Balboa, *Standley 25238, 26429.* PANAMÁ: Taboga Island, *Hitchcock 8095.*

2. PENNISETUM COMPLANATUM (Nees) Hemsl. Biol. Centr. Amer. Bot. 3:507. 1885.

Gymnothrix complanata Nees, Bonplandia 3:83. 1855.
Gymnothrix mexicana Fourn. Mex. Pl. 2:48. 1886.
Gymnothrix grisebachiana Fourn. Mex. Pl. 2:48. 1886.

Coarse, somewhat woody perennial; culms erect or ascending from strong rhizomes, sometimes geniculate at the lower nodes, simple, or sparingly branching, mostly 1–2 m. high, sometimes dwarf; sheaths usually as long as or longer than the internodes, loose, keeled toward the summit, glabrous, or the margins pilose above; ligule densely ciliate, about 2 mm. long; blades elongate, attenuate, 5–8 mm., or even 10 mm., wide, very scabrous; panicles 7–16 cm. long, nodding or flexuous, the spikelets pale, the bristles tawny or purple; fascicles ascending, containing 1 spikelet, the bristles usually numerous, slender, 12–15 mm. long, the

innermost stouter, 15–25 mm. long; spikelets 6–7 mm. long, acuminate, minutely scabrous; first glume thin, 1-nerved, acute or obtuse, about one-third as long as the spikelet; second glume 5-nerved, three-fourths as long as the spikelet; sterile lemma 5-nerved, acuminate, a little shorter than the fruit, enclosing a palea and sometimes a staminate flower; fruit acuminate, the lemma scabrous above, the palea pubescent, the tip not enclosed.

Dry slopes and savannas, southern Mexico (Veracruz) to Panama.

CHIRIQUÍ: El Boquete, *Hitchcock 8250.* WITHOUT LOCALITY: *Seeman 1560* (TYPE).

64. CENCHRUS L.

CENCHRUS L. Sp. Pl. 1049. 1753.

Rarum Adans. Fam. Pl. 2:35, 597. 1763.
Cenchropsis Nash in Small, Fl. Southeast. U. S. 109. 1903.

Spikelets sessile, enclosed in spiny burs composed of united sterile branches, the burs falling entire, the body of the bur irregularly lobed, the lobes rigid, the spines barbed; spikelets 1 to several in each bur, usually glabrous; first glume narrow, 1-nerved, much shorter than the spikelet, sometimes wanting; second glume and sterile lemma nearly equal, 3- to 5-nerved, the lemma enclosing a palea and usually a staminate flower; fruit indurate, the lemma acuminate, the margins thin, flat.

Annuals or perennials with terminal racemes of burs.

a. Burs subtended by a ring of slender bristles; spikelets 3 or 4 in each bur.
  b. Burs not more than 4 mm. wide, densely crowded in a long spike, the lobes interlocking; first glume obsolete ..... 1. C. BROWNII
  bb. Burs 5–7 mm. wide, not crowded, the lobes usually erect; first glume present ..... 2. C. ECHINATUS
aa. Burs not subtended by a ring of slender bristles; spikelets usually 2 in each bur ..... 3. C. PAUCIFLORUS

1. CENCHRUS BROWNII Roem. & Schult. Syst. Veg. 2:258. 1817.

Cenchrus inflexus R. Br. Prodr. Fl. Nov. Holl. 1:195. 1810. Not *C. inflexus* Poir., 1804.
Cenchrus viridis Spreng. Syst. Veg. 1:301. 1825.
Cenchrus echinatus var. *viridis* Spreng. ex Griseb. Fl. Brit. W. Ind. 556. 1864.

Annual; culms erect to decumbent-spreading and rooting at the lower nodes, simple to freely branching; sheaths mostly longer than the internodes, compressed, keeled, glabrous; ligule ciliate, less than 1 mm. long; blades 10–30 cm. long, mostly 6–8 mm., or sometimes as much as 12 mm. wide, scabrous to nearly glabrous; spikes 4–10 cm. long, dense, the axis minutely scabrous or pubescent; burs about 4 mm. wide, subtended by a ring of slender irregular bristles, the lobes pubescent, interlocking; spikelets usually 3 in each bur, 4–4.5 mm. long; first glume obsolete; second

Fig. 29. *Cenchrus brownii*

glume two-thirds to three-fourths as long as the subequal sterile lemma and fruit; fruit acuminate, minutely roughened, the nerves evident near the tip.

Common in open ground, often a weed in cultivated ground and waste places, Florida, Mexico, and the West Indies to Bolivia and Brazil; also in Australia and south Pacific islands.

Often called pega-pega and cadillo in Panama.

CHIRIQUÍ: Puerto Armuelles, *Woodson & Schery 839.* COLON: Colón, *Rose 22082.* CANAL ZONE: Toro Point, *Hitchcock 8043;* Monte Lirio, *Maxon 6846;* Barro Colorado Island, *Standley 31244;* Empire, *Pittier 3716;* Culebra, *Hitchcock 7914; Pittier 2080;* Pedro Miguel, *Allen 5;* Corozal, *Piper 5264;* Ancón, *Killip 4007; Standley 26323; Piper 5249;* Balboa, *Standley 27406.* PANAMÁ: Matías Hernández, *Pittier 6790;* Panamá, *Piper 5284;* Taboga Island, *Hitchcock 8064; Killip 4149; Standley 27873; Piper 5284.*

2. CENCHRUS ECHINATUS L. Sp. Pl. 1050. 1753.

Cenchrus pungens H.B.K. Nov. Gen. & Sp. 1:115. 1815.
Cenchrus brevisetus Fourn. Mex. Pl. 2:50. 1886.
Cenchrus echinatus brevisetus Scribn. in Millsp. Field Mus. Bot. 2:26. 1900.

Annual; culms erect to geniculate or decumbent-spreading, often rooting at the nodes, branching, as much as 1 m. long, glabrous; sheaths compressed, keeled, glabrous, or ciliate on the margins near the summit; ligule ciliate, 1 mm. long; blades mostly 6–20 cm. long, 3–8 mm. wide, acuminate, more or less pilose; spikes 3–10 cm. long, the axis rather stout, flexuous, scabrous; burs scarcely crowded, 4–7 cm. long, usually broader than long, pubescent, containing 3–6 spikelets, the bristles below the bur fewer and stouter than in *C. brownii,* the lobes or spines erect to spreading, retrorsely barbed at the tip; spikelets 4.5–6 mm. long; first glume small, narrow, 1-nerved, the second two-thirds to three-fourths as long as the nearly equal fruit and sterile lemma; fruit acuminate, the nerves of the lemma apparent near the tip.

Open, especially sandy, ground, and waste places, southern United States and the West Indies to Argentina.

CANAL ZONE: between Mindi and Colón, *Hitchcock 7949;* Frijoles, *Standley 27649;* Ancón, *Bro. Celestine 27;* Balboa, *Hitchcock 7994, 8001; Maxon 6837; Standley 30875.* PANAMÁ: Bella Vista, *Standley 25376;* Taboga Island, *Woodson, Allen & Seibert 1540.*

3. CENCHRUS PAUCIFLORUS Benth. Bot. Voy. Sulph. 56. 1840.

Cenchrus roseus Fourn. Mex. Pl. 2:50. 1886.
Cenchrus echinatus forma *longispina* Hack. in Kneucker, Allg. Bot. Zeitschr. 9:169. 1903.

Similar in habit and aspect to the preceding but commonly with shorter and narrower blades; spikes usually 3–8 cm. long, short-exserted or partly included in the sheath; burs 3–7 mm. wide, pubescent or nearly glabrous, with no ring of slender bristles at the base, the lobes flat at the base, erect or spreading, sometimes inflexed, usually enclosing two spikelets; spikelets 5–7 mm. long; first glume narrow, about one-third as long as the spikelet; second glume and sterile lemma subequal or the lemma as long as the acuminate fruit.

Open sandy ground, United States and the West Indies to Argentina.

PANAMÁ: Point Chamé, *Hitchcock 8164.*

65. LITHACHNE Beauv.

Lithachne Beauv. Ess. Agrost. 135. *pl. 24. f. 2.* 1812.

Plants monoecious; panicles small, the terminal staminate or wanting, the axillary composed of 1 pistillate spikelet and several staminate spikelets below it; pistillate spikelet: first glume wanting; second glume and sterile lemma nearly equal, acuminate, 5- to 7-nerved; fruit laterally compressed, bony-indurate, white, smooth and shining, the lemma gibbous, the margins tightly enclosing the convex palea; staminate spikelets reduced to the lemma and palea.

Wiry perennials with broad asymmetrical blades and small terminal and axillary panicles.

1. Lithachne pauciflora (Swartz) Beauv. ex Poir. Dict. Sci. Nat. 27:60. 1823.

Olyra pauciflora Swartz, Prodr. Veg. Ind. Occ. 21. 1788.
Olyra axillaris Lam. Encycl. 4:547. 1797.
Lithachne axillaris Beauv. Ess. Agrost. 166. *pl. 24. f. 2.* 1812.

Fig. 30. *Lithachne pauciflora*

Slender erect perennial; culms tufted, woody, 25–50 cm. high, more or less geniculate at the lower nodes; sheaths, except the uppermost, shorter than the

internodes, glabrous or minutely pubescent, sometimes ciliate on the margin, the lower ones bladeless; ligule ciliate, about 1 mm. long; blades asymmetrical, acuminate, 5–8 cm. long, 1.5–2.5 cm. wide, glabrous, the margins scabrous; staminate spikelets 4–6 mm. long, acuminate; pistillate spikelets about 10 mm. long, the second glume a little longer than the sterile lemma; fruit 4–5 mm. long, triangular-gibbous, smooth and shining, white, or sometimes mottled brown.

Moist rich woods, Mexico and the West Indies to Panama; Brazil to Argentina.

CHIRIQUÍ: El Boquete, *Hitchcock 8310.* CANAL ZONE: Culebra, *Hitchcock 9211.*

66. RADDIA Bertol.

RADDIA Bertol. Opusc. Sci. Bologna 3:410. 1819.
Strephium Schrad. in Nees, Agrost. Bras. 298. 1829.

Plants monoecious, the staminate and pistillate spikelets in small separate inflorescences, the staminate terminal and axillary, the pistillate all axillary from the middle and upper nodes; staminate spikelets lanceolate, acute or acuminate, the glumes and sterile lemma wanting; first glume of pistillate spikelet wanting; second glume and sterile lemma membranaceous, equal, acute or acuminate; fruit sessile, indurate, the margins of the lemma firmly enclosing the palea.

Slender, erect or spreading perennials with short, broad, flat blades and small few-flowered panicles partly enclosed in the sheaths.

1. RADDIA NANA (Doell) Chase, Proc. Biol. Soc. Washington 21:185. 1908.
Olyra nana Doell in Mart. Fl. Bras. 2^2:329. 1877.

Delicate perennial; culms 10–40 cm. long, very slender, lax or straggling, naked below, simple, or branching from the upper nodes, appressed-pubescent to glabrous, the lower internodes elongate, the upper very much shorter; sheaths pubescent, often pilose on the margins, the lower much shorter, the upper about as long as or a little longer than the internodes; blades very shortly petiolate, 10–20 mm. long, 5–7 mm. wide, spreading or reflexed, oblong-triangular, rounded at the apex, the tip abruptly acute or mucronate, the base truncate, ciliate; racemes very small, axillary, 2- to 3-flowered, all partly enclosed in the sheaths; staminate spikelets 3–4 mm. long, green, glabrous; pistillate spikelets 2 mm. long, brown, densely pubescent with white hairs; second glume and sterile lemma acute, slightly longer than the fruit; fruit obovate, acute, plump, smooth and shining.

Wet savannas, shady stream banks and crevices of rocks, Trinidad, Panama, Venezuela, and Brazil.

PANAMÁ: Hacienda La Joya, *Dodge, Hunter, Steyermark & Allen 16882.*

67. CRYPTOCHLOA Swallen

CRYPTOCHLOA Swallen, Ann. Mo. Bot. Gard. 29:317. 1942.

Monoecious; inflorescences small, usually partly hidden in the upper sheaths, each bearing both staminate and pistillate spikelets in no definite arrangement;

staminate spikelet: glumes and sterile lemma wanting; lemma and palea acute or acuminate, thin, the lemma 1-nerved; stamens 3; pistillate spikelet: first glume wanting; second glume and sterile lemma acuminate, subequal, 3- or usually 5-nerved, the lateral nerves approximate, finely transversely veined; fertile floret subcylindrical, raised on the enlarged and thickened segment of the rachilla; lemma firm, subindurate, smooth and shining, gradually narrowed to a blunt tip, the margins not inrolled; palea as long as the lemma, similar in texture.

Low perennials with broad flat blades usually crowded toward the top of the slender wiry culms.

1. Cryptochloa variana Swallen, Ann. Mo. Bot. Gard. 29:318, *with f.* 1942.

Culms in small dense tufts, wiry, 10–20 cm. high, erect to spreading, often geniculate at the densely pubescent nodes, glabrous, or pubescent below the nodes, the lower internodes somewhat elongate, the upper ones much shorter, completely hidden by the overlapping sheaths; sheaths keeled, pubescent toward the summit

Fig. 31. *Cryptochloa variana*

and on the margins, nearly glabrous on the back, often auriculate, the auricle fused with the ligule, the lower ones bladeless or with very much reduced blades; ligule 1–3 mm. long, membranaceous, obtuse, puberulent on the back or nearly glabrous; blades 3–5 on each culm, crowded toward the summit, 3–5 cm. long, 8–13 mm. wide, oblong-lanceolate, rather abruptly narrowed to an acute or acuminate tip, broad and rounded at the base, with a densely pubescent petiole

about 1 mm. long, minutely pubescent on both surfaces or sometimes only obscurely puberulent; inflorescences terminal and axillary, partly enclosed in the sheaths, 2–3 cm. long, bearing 1–6 pistillate spikelets, the branches closely appressed, usually pubescent; staminate spikelets 2.5 mm. long, the lemma subacute, the palea as long as or slightly longer than the lemma; anthers 1 mm. long; pistillate spikelet 7–8.5 mm. long, the pedicel 4–10 mm. long, relatively stout, much enlarged toward the summit; second glume and sterile lemma 3-nerved, with a few fine transverse nerves, glabrous or obscurely scaberulous, the second glume acute, the sterile lemma acute or subacuminate, slightly exceeding the second glume; fruit 6.5–7 mm. long, 2 mm. broad, subcylindrical, broadest above the middle, gradually narrowed to a blunt tip, smooth, shining, gray-greenish, at maturity mottled with darker drab; caryopsis 4.5 mm. long, light brown.

Forests, Panama and Colombia.

COCLÉ: El Valle de Antón, *Allen 2201* (TYPE). CANAL ZONE: Madden Reservoir, *Muenscher 12212*.

68. OLYRA L.

OLYRA L. Syst. Nat. ed. 10. 2:1261. 1759.

Plants monoecious; staminate and pistillate spikelets in the same inflorescence, the pistillate on the upper branches and at the ends of the lower branches, the staminate scattered along the lower branches; pedicels of pistillate spikelets enlarged toward the summit; pistillate spikelet: first glume wanting; second glume and sterile lemma 5- to 7-nerved, caudate-acuminate, the glume much longer than the lemma; fruit bony-indurate, white, the margins inrolled, clasping the palea; staminate spikelets much smaller, reduced to the lemma and palea.

Erect or clambering, usually woody perennials with broad flat blades and open panicles terminating the main culm and branches.

1. OLYRA LATIFOLIA L. Syst. Nat. ed. 10. 2:1261. 1759.

Olyra paniculata Swartz, Prodr. Veg. Ind. Occ. 21. 1788.
Olyra arundinacea H.B.K. Nov. Gen. & Sp. 1:197. 1816.
Olyra latifolia var. *arundinacea* Griseb. Fl. Brit. W. Ind. 535. 1864.

Woody perennial; culms erect, freely branching from the upper nodes, as much as 5 m. long, the branches often clambering over the surrounding vegetation; sheaths glabrous, pubescent or hispid, usually longer than the internodes, the lower ones of the main culm short, nearly bladeless; blades asymmetrical, 10–30 cm. long, 2–9.5 cm. wide, or those of the branches smaller, acuminate, scabrous, short-petiolate, the petioles hispid; panicles 5–15 cm. long, terminal on the main culm and branches, sometimes axillary from the upper sheath, the branches usually narrowly ascending, with a single pistillate spikelet at the end, the staminate spikelets scattered on short branchlets below it; staminate spikelets 5 mm. long, the lemma awned, the awn 2–3 mm. long; second glume and sterile lemma of the

pistillate spikelets 10–25 mm. long, long-acuminate, divergent, exposing the fruit; fruit 5–6 mm. long, smooth and shining, white to drab.

Moist woods and thickets, Florida, Mexico, and the West Indies to Bolivia and Argentina.

BOCAS DEL TORO: Isla Colón, *von Wedel 1343;* Old Bank Island, *von Wedel 1974;* Pumpkin River, *von Wedel 2567.* CHIRIQUÍ: San Felix, *Pittier 5206;* San Bartolomé, *Woodson & Schery 882.* COLÓN: Santa Isabel, *Pittier 4151;* Palenque, *Pittier 4126.* CANAL ZONE: Fort Lorenzo, *Piper 5949;* Gatún, *Hitchcock 7983;* Río Abajo, *Bartlett & Lasser, 16399;* Frijoles, *Pittier 2686, 3759; Standley 27533;* Barro Colorado Island, *Standley 31335; Bailey & Bailey 17;* Pedro Miguel to Culebra, *Hitchcock 7919;* East Paraíso, *Standley 29937;* Ancón, *Piper 5226;* Chivi-Chivi Trail near Red Tank, *Piper 5229; Maxon & Harvey 6580;* Balboa, *Standley 25437.* PANAMÁ: Alhajuela, *Pittier 2339, 3470;* Juan Díaz, *Standley 30607; Killip 4089;* Panamá, *Hitchcock 8101;* Matías Hernández, *Pittier 6643;* Río Indio, trail to Chico, *Steyermark & Allen 17458;* Pedro Gonzales, Perlas Islands, *Allen 2596.*

69. PARIANA Aubl.

PARIANA Aubl. Pl. Guian. 2:876. *pl. 337.* 1775.

Spikelets unisexual, arranged in whorls at the nodes of a readily disarticulating axis, the whorls falling entire, each composed of 1 pistillate spikelet surrounded and enclosed by 4 or 5 staminate spikelets; pedicels of staminate spikelets thickened, indurate, united; staminate spikelets dorsally compressed; glumes acute or acuminate, 1- to 3-nerved, one-third to half as long as the spikelet; lemma broad, 3-, rarely 5-, nerved, acute to obtuse; stamens numerous; pistillate spikelet completely hidden by the staminate spikelets; glumes thin, acute, 1- to 3-nerved; fruit indurate, resembling that of *Olyra.*

Perennials with broad flat blades and terminal spikes. Culms dimorphic (in our species), the sterile ones leafy, the fertile ones leafless.

a. Blades 2–2.5 cm. wide; sheaths fimbriate in the mouth; glumes of staminate spikelets 2–3 mm. long, 2- to 3-nerved, the lemma 4 mm. long ..... 1. P. SIMULANS
aa. Blades 4.5–5.3 cm. wide; sheaths not fimbriate in the mouth; glumes of staminate spikelet 4–5 mm. long, 1-nerved, the lemma 5–6 mm. long ..... 2. P. STRIGOSA

1. PARIANA SIMULANS Tutin, Jour. Linn. Soc. Bot. 50:357. *f. 22. pl. 10.* 1936.

Erect tufted perennial; sterile culms about 60 cm. high; lower sheaths much shorter than the long internodes, bladeless, that of the midculm with a well-developed blade, the upper ones crowded, fimbriate in the mouth, the bristles about 1 cm. long; blades 8–12 cm. long, 2–2.5 cm. wide, acuminate, glabrous; fertile culms about 30 cm. high, weak and soft, hidden under the foliage of the sterile culms; sheaths loose, inflated, glabrous, about half as long as the internodes, bladeless; spike about 4 cm. long, scarcely exserted from the upper sheath; staminate spikelets: pedicels 3 mm. long, ciliate on the margins; glumes 2–3 mm. long, 2- to 3-nerved, triangular-acuminate; lemma 4 mm. long, 1.5 mm. wide, oblong, abruptly subacute; fertile spikelets: glumes lanceolate-acuminate, 6 mm. long; fruit ovate, 5 mm. long, puberulent.

Forests, Costa Rica, Panama and Colombia.

COLÓN: Loma de la Gloria, *Pittier 4075* (TYPE). CANAL ZONE: Quebrada Culebra, *Dodge & Allen 17058*. This collection is doubtfully referred to *P. simulans*. The blades are wider, as much as 3.5 cm. wide, and there are no fimbriate bristles at the mouth of the sheaths. The inflorescence, however, is identical.

2. PARIANA **strigosa** Swallen, sp. nov.

Perennis culmis dimorphis; culmi steriles 40–65 cm. alti, infra nodos strigosi; vaginae inferiores internodiis multo breviores, strigosae, superiores internodiis longiores non fimbriatae; ligula truncata, ca. 2 mm. longa; laminae ovatae vel ovato-lanceolatae, acuminatae, 12–15 cm. longae, 4.5–5.3 cm. latae, marginibus scabris, infra glaucescentibus; culmi fertiles ca. 45 cm. alti, debiles, efoliati; spica 7 cm. longa; spiculae masculae: glumae 4–5 mm. longae, acuminatae, 1-nerves; lemma 5–6 mm. longum, abrupte subacutum viride vel purpurascens; spiculae feminae: glumae 6 mm. longae, 1-nerves, acutae, pubescentes; fructus 5 mm. longus, ovatus, abrupte subacutus.

Tufted perennial with dimorphous culms; sterile culms 40–65 cm. high, strigose below the nodes; lower sheaths much shorter than the internodes, strigose, the upper ones overlapping but not crowded, not fimbriate in the mouth; ligule truncate, about 2 mm. long; blades 2–3 at the summit of the culms, not crowded, ovate to ovate-lanceolate, acuminate, 12–15 cm. long, 4.5–5.3 cm. wide, scabrous at the tip and on the margins, grayish-green above, glaucous below; fertile culms about 45 cm. high, weak, soft, bladeless; spike 7 cm. long; staminate spikelets: pedicels 2–3 mm. long, villous at the base; glumes 4–5 mm. long, 1-nerved, narrow, acuminate; lemma 5–6 mm. long, oblong, abruptly subacute, tinged with purple; fertile spikelet: glumes 6 mm. long, 1-nerved, acute, thin, pubescent; fruit 5 mm. long, ovate, abruptly subacute.

PANAMÁ: Río Indio, in "forest along small unnamed quebrada entering lake at 70 m. level, 70–80 m.," *Dodge & Allen 17301* (U. S. Nat. Herb., TYPE).

Known only from the type collection.

70. IMPERATA Cyrillo

IMPERATA Cyrillo, Pl. Rar. Neap. 2:26. 1792.

Spikelets all alike, in pairs, unequally pedicellate on a slender continuous rachis of a raceme, surrounded at the base by long silky hairs much longer than the spikelets; pedicels of the spikelets enlarged at the summit into a shallow cupped receptacle; glumes about equal, acuminate, the first 5- to 7-nerved; sterile lemma and fertile lemma and palea hyaline, the fertile lemma awnless.

Tough perennial grasses with long rather stout rhizomes, flat blades narrowed to a petiole-like base, and narrow silky inflorescences.

1. IMPERATA CONTRACTA (H.B.K.) Hitchc. Rep. Mo. Bot. Gard. 4:146. 1893.

Saccharum contractum H.B.K. Nov. Gen. & Sp. 1:182. 1816.

Saccharum caudatum G. Meyer, Prim. Fl. Esseq. 68. 1818.
Anatherum caudatum Schult. Mant. 2:445. 1824.
Anatherum portoricense Spreng. Syst. Veg. 1:290. 1825.
Imperata caudata Trin. Mém. Acad. St. Pétersb. VI. Math. Phys. Nat. 2:331. 1832.

Strongly rhizomatous perennial; culms erect, solitary or few together, 1–1.5 m. high; sheaths much longer than the internodes, rounded or keeled toward the summit, glabrous, the lower ones bladeless; ligule brown, not more than 0.5 mm. long; blades elongate, attenuate, usually some of them narrowed to a long petiole-like base, narrower than the mouth of the sheath, 5–10 mm. wide, the margins very scabrous; panicles mostly 30–40 cm. long, narrowed-attenuate toward the summit, the upper branches short and appressed, the lower ones slender, ascending to spreading, somewhat curved or flexuous, commonly 5–10 cm. long; spikelets 3 mm. long, obscured by the long silky hairs on the glumes and callus.

Hierba guayacán.

Grassy hills, banks, and fields, Mexico and the West Indies to Brazil and Peru.

BOCAS DEL TORO: Shepherd Island, *von Wedel 2715*. CHIRIQUÍ: David, *Hitchcock 8357*. CANAL ZONE: Toro Point, *Hitchcock 8049;* Fort Sherman, *Standley 31229;* Frijoles, *Killip 4293; Standley 27644;* Tabernilla, *Hitchcock 8386*; Culebra, *Hitchcock 7934;* Summit, *D. H. Popenoe 20;* between Miraflores and Pedro Miguel, *Pittier 3966;* Balboa, *Standley 25633*.

71. SACCHARUM L.

SACCHARUM L. Sp. Pl. 54. 1753.

Spikelets all alike, in pairs, one sessile, the other pedicellate, surrounded at the base by long silky hairs, the rachis readily disarticulating below the spikelets; glumes rather firm, 1- to 3-nerved, acute or acuminate; sterile lemma similar to the glumes but hyaline, the fertile lemma shorter than the glumes, hyaline, awnless, sometimes wanting.

Tall, coarse perennial grasses with large plume-like inflorescences of panicled racemes.

1. SACCHARUM OFFICINARUM L. Sp. Pl. 54. 1753.

Perennial; culms erect or ascending, as much as 4 m. high, glabrous, the lower internodes short; sheaths overlapping, rounded, glabrous, or softly pubescent toward the summit, densely villous in the throat, the lower ones readily falling away from the culm; ligule firm, dark brown, truncate, minutely ciliate, about 5 mm. long; blades elongate, broad, with prominent midnerve, sharply serrate, densely pubescent or villous on the upper surface at the base; panicles very large, dense, plumy, silvery or pinkish, the long branches drooping; spikelets 4–5 mm. long.

Sugarcane; Caña de azúcar.

Cultivated throughout tropical regions.

CANAL ZONE: Frijoles, *Hitchcock 8390;* Balboa, *Standley 25640*.

72. ERIOCHRYSIS Beauv.

ERIOCHRYSIS Beauv. Ess. Agrost. 8. *pl. 4. f. 11.* 1812.

Spikelets in pairs, the sessile spikelets perfect, the pedicellate somewhat smaller, pistillate, the rachis finally disarticulating below the spikelets; glumes equal, indurate, densely covered on the margins and on the back toward the summit with golden-brown silky hairs; fertile lemma awnless.

Tufted perennial grasses with short racemes arranged in a very dense, lobed, brown, silky inflorescence.

1. ERIOCHRYSIS CAYENNENSIS Beauv. Ess. Agrost. 8. *pl. 4. f. 11.* 1812.

Saccharum cayennense Benth. Jour. Linn. Soc. Bot. 19:66. 1881.

Coarse, densely tufted perennial; culms erect, commonly 1.5–2 m. high, the nodes bearded, otherwise glabrous; sheaths densely and softly villous, especially toward the summit, less so below, elongate, overlapping, or sometimes, especially the upper bladeless sheaths, shorter than the internodes; ligule 12 mm. long, thin, white, truncate; blades villous like the sheaths, 15–40 cm. long, 5–12 mm. wide, flat or folded, firm; panicles golden-brown, very dense and spike-like, interrupted below, 8–20 cm. long, 2–3 cm. wide, the branches short, appressed, densely villous in the axils with long hairs; spikelets 2.5–3 mm. long, the first glume glabrous on the back, the tip and margins fringed with brown silky hairs.

Marshes and bogs or sometimes grassy hills, southern Mexico and the West Indies to Uruguay.

CHIRIQUÍ: El Boquete, *Hitchcock 8265, 8319; Woodson & Schery 741*; valley of Río Caldera, near El Boquete, *Killip 4580.*

73. POLYTRIAS Hack.

POLYTRIAS Hack. in DC. Monogr. Phan. 6:189. *pl. 1. f. 13.* 1889.

Spikelets all perfect, in threes at the nodes of a slender disarticulating rachis, two sessile, placed back to back, the other pedicellate; first glume membranaceous, obtuse, densely hairy; sterile lemma wanting; fertile lemma hyaline, awned at the apex, the awn geniculate, twisted.

Low slender perennials with short narrow blades, and short, solitary, golden- or reddish-brown racemes.

1. POLYTRIAS PRAEMORSA (Nees) Hack. in DC. Monogr. Phan. 6:189. 1889.

Pollinia praemorsa Nees, Jour. Bot. Kew Misc. 2:98. 1850.
Andropogon amaurus Buse ex Miquel, Pl. Jungh. 360. 1854.
Andropogon diversiflorus Steud. Syn. Pl. Glum. 1:370. 1854.
Polytrias amaura Kuntze, Rev. Gen. Pl. 2:788. 1891.
Polytrias diversiflora Nash, Torreya 5:110. 1905.

Stoloniferous perennial; culms slender, decumbent-spreading, the ascending ends rising to a height of 15–30 cm., glabrous, or the lower nodes appressed-pubescent; sheaths glabrous to pilose, keeled, the lower longer, the upper usually

much shorter than the internodes; ligule a ciliate membrane about 0.5 mm. long; blades 2–6 cm. long, 1–3 mm. wide, flat, acuminate, papillose-pilose on both surfaces, the margins scabrous; raceme 2.5–5.5 cm. long, golden- or reddish-brown; spikelets 3 mm. long, the awn 7–8 mm. long, geniculate, tightly twisted below the bend, loosely twisted above.

Introduced in America in Panama, Cuba, Puerto Rico, Trinidad, and Venezuela. A native of the Philippines and Java. Cultivated as a lawn grass.

Java grass.

CANAL ZONE: Barro Colorado Island, *Standley 41124;* Summit, *Standley 30140.*

74. ANDROPOGON L.

ANDROPOGON L. Sp. Pl. 1045. 1753.

Schizachyrium Nees, Agrost. Bras. 331. 1829.
Bothriochloa Kuntze, Rev. Gen. Pl. 2:767. 1891.
Amphilophis Nash in Britton, Man. 71. 1901.

Spikelets arranged in pairs at each node of a disarticulating rachis, one sessile and perfect, the other pedicellate and staminate, neuter, or sterile, often very much reduced, the rachis and sterile pedicels sparsely to usually densely ciliate or villous; glumes of sessile spikelet indurate, the first flat or rounded on the back, several-nerved, the median nerve obscure or wanting, the margins keeled toward the summit; sterile lemma hyaline; fertile lemma hyaline, narrow, much shorter than the glumes, awnless or usually awned from the apex or from between minute lobes, the awns straight, or geniculate and twisted below; pedicellate spikelets as large as the sessile, or more or less reduced, sometimes only the pedicel present, the glumes not indurate.

Annuals or perennials with solid culms, the spikelets arranged in racemes, these sessile and crowded on a common axis, paniculate, or usually solitary or paired, sometimes in 3's or 5's, the common peduncle enclosed or exserted from a spathe-like sheath, these sheaths aggregate in a loose or dense, often silky, compound inflorescence.

a. Racemes solitary on each peduncle.
  b. Plants annual; culms slender, widely spreading ..... 1. A. BREVIFOLIUS
  bb. Plants perennial; culms coarser, erect, densely cespitose.
    c. Spikelets awnless; racemes 1 cm. long, nearly glabrous; inflorescence dense ..... 5. A. VIRGATUS
    cc. Spikelets awned; racemes 2–8 cm. long; inflorescences loose, the racemes scattered, or if dense, plume-like.
      d. Racemes very flexuous, conspicuously villous, crowded in a dense plume-like inflorescence ..... 6. A. CONDENSATUS
      dd. Racemes straight, not conspicuously villous, the spikelets appressed.
        e. First glume of sessile spikelet usually densely villous ..... 2. A. HIRTIFLORUS
        ee. First glume of sessile spikelet glabrous.
          f. Rachis joints 4–5 mm. long; spikelets not crowded, the sessile one commonly 5–6 mm. long; blades 2–5 mm. wide ..... 3. A. SEMIBERBIS
          ff. Rachis joints 2–3 mm. long; spikelets rather crowded, the sessile one about 4 mm. long; blades usually not more than 1.5 mm. wide ..... 4. A. TENER

aa. Racemes 2 or more, digitate, paniculate, or crowded along a common axis.
b. Racemes numerous, sessile, crowded along a common axis in a dense, white, or silvery inflorescence. Culms erect ..... 14. A. SACCHAROIDES
bb. Racemes few to several, paniculate, the panicles terminal on the main culm and short branches. Culms decumbent or straggling, rooting at the nodes ..... 13. A. CONDYLOTRICHUS
bbb. Racemes 2–5, sessile, paired or digitate at the ends of the peduncles.
c. Spikelets awnless.
d. Plants slender, usually less than 1 m. high; spathes not aggregate.
e. Ligule 1–2 mm. long; tips of blades acute, not boat-shaped; spikelets 3 mm. long ..... 10. A. LEUCOSTACHYUS
ee. Ligule less than 1 mm. long; tips of blades boat-shaped; spikelets about 4 mm. long ..... 11. A. SELLOANUS
dd. Plants robust, 1–2.5 m. high; spathes aggregate in a usually dense inflorescence ..... 7. A. BICORNIS
cc. Spikelets awned.
d. Awns geniculate, twisted below; spikelets of the lower pairs alike; second glume with a slender divergent awn ..... 12. A. ANGUSTATUS
dd. Awns slender, straight; spikelets of the lower pairs unlike.
e. Racemes aggregate in a dense compound inflorescence, the spathes inconspicuous, rarely equaling the racemes; ultimate branchlets densely villous below the spathes ..... 8. A. GLOMERATUS
ee. Racemes scattered in a long loose inflorescence, the spathes conspicuous, exceeding the racemes; ultimate branchlets glabrous or nearly so below the spathes ..... 9. A. VIRGINICUS

1. ANDROPOGON BREVIFOLIUS Swartz, Prodr. Veg. Ind. Occ. 26. 1788.

Andropogon obtusifolius Poir. in Lam. Encycl. Suppl. 1:583. 1810.
Pollinia brevifolia Spreng. Pl. Pugill. 2:13. 1815.
Schizachyrium brevifolium Nees ex Kunth, Enum. Pl. 1:488. 1833.
Sorghum brevifolium Kuntze, Rev. Gen. Pl. 2:791. 1891.

Slender annual; culms 15 cm. to nearly 1 m. long, forming loose tangles or dense mats, ascending from a decumbent base or trailing, freely branching, glabrous; sheaths usually much shorter than the internodes, compressed, keeled, glabrous; ligule membranaceous, about 0.5 mm. long; blades oblong, obtuse, navicular, 1–4 cm. long, 1–5 mm. wide, glabrous, the margins scaberulous, minutely ciliate at the base; flowering branches slender, numerous, from the middle and upper nodes; racemes solitary, delicate, 1–2 cm. long, partly included in the spathe, the rachis and sterile pedicel glabrous; sessile spikelet 2.5–3 mm. long, the callus bearded, otherwise glabrous, the slender awn about 8 mm. long, geniculate, tightly twisted below the bend; pedicellate spikelet reduced to a minute slender-awned rudiment.

Savannas, moist banks, and brushy slopes, southern Mexico and the West Indies to Bolivia and Brazil; tropical regions of both hemispheres.

COCLÉ: Aguadulce, *Pittier 4868, 5054.* CANAL ZONE: Mount Hope Cemetery, *Standley 28794;* Gamboa, *Standley 28362;* Culebra, *Hitchcock 7953, 9169;* Summit, *D. H. Popenoe 24;* Corozal, *Standley 27395;* Balboa, *Standley 26446.* PANAMÁ: Sabana of Panamá, *Pittier 2545;* Orange River, *Killip 4257;* Hacienda La Joya, *Dodge, Hunter, Steyermark & Allen 16880;* Río Tecúmen, *Standley 26633.*

2. ANDROPOGON HIRTIFLORUS (Nees) Kunth, Rév. Gram. 1: Suppl. XXXIX. 1830.

Streptachne domingensis Spreng. ex Schult. Mant. 2:188. 1824. Not *Andropogon domingensis* Steud., 1821.
Schizachyrium hirtiflorum Nees, Agrost. Bras. 334. 1829.
Aristida? domingensis Kunth, Rév. Gram. 1:62. 1829.
Andropogon oligostachyus Chapm. Fl. South. U. S. 581. 1860.
Andropogon hirtiflorus var. *oligostachyus* Hack. in DC. Monogr. Phan. 6:372. 1889.
Sorghum hirtiflorum Kuntze, Rev. Gen. Pl. 2:792. 1891.
Schizachyrium oligostachyum Nash in Small, Fl. Southeast. U. S. 59. 1903.
Schizachyrium domingense Nash, N. Amer. Fl. 17:103. 1912.
Andropogon domingensis F. T. Hubb. Proc. Amer. Acad. 49:493. 1913.

Perennial; culms tufted, erect, 0.4–1.5 m., commonly about 1 m. high, glabrous; sheaths shorter than the internodes, or the lower ones overlapping, glabrous, keeled, at least toward the summit; ligule 1–1.5 mm. long, brownish; blades 10–20 cm. long, 2–4 mm. wide, or on robust plants as much as 30 cm. long and 8 mm. wide, scaberulous, the margins scabrous; racemes mostly 4–8 cm. long, few to numerous, scattered on the flowering branches from the upper nodes, forming a loose inflorescence; rachis and sterile pedicels densely villous all over or only on the sides; sessile spikelet 5–6 mm. long, sparsely to densely villous, the middle of the back sometimes glabrous, the awn about 1 cm. long, geniculate, tightly twisted below the bend, loosely twisted above; pedicellate spikelet reduced to a small scabrous, short-awned rudiment.

An extremely variable species in size, habit, and pubescence of the racemes.

Savannas and grassy hills, southern United States and the West Indies to Paraguay and Peru.

CHIRIQUÍ: El Boquete, *Hitchcock 8237, 8238, 8239; Killip 4545.* PANAMÁ: Río Azote Caballo, *Dodge, Steyermark & Allen 16861.*

3. ANDROPOGON SEMIBERBIS (Nees) Kunth, Rév. Gram. 1: Suppl. XXXIX. 1830.
Schizachyrium semiberbe Nees, Agrost. Bras. 336. 1829.

Very similar to *A. hirtiflorus*, differing primarily in the glabrous or scabrous first glume of the sessile spikelet, and the glabrous or only sparsely hairy rachis and sterile pedicels, the hairs confined to the margins near the summit; culms stouter, on the average, the blades rarely less than 4 mm. long.

Savannas and dry or rocky hills and cliffs, Florida, eastern Mexico, and the West Indies to Ecuador and Argentina.

CANAL ZONE: between Panamá and Corozal, *Hitchcock 9187;* Ancón Hill, *Standley 26356.* PANAMÁ: Las Sabanas, *Standley 40776;* Chorrera, *Hitchcock 8146;* Taboga Island, *Hitchcock 8086, 8091; Killip 4145.*

Hitchcock 9187 and *Standley 26356* differ from typical specimens in having more slender racemes and sessile spikelets scarcely more than 4 mm. long, but the plants are coarse with broad blades as in *A. semiberbe*.

4. ANDROPOGON TENER (Nees) Kunth, Rév. Gram. 1: Suppl. XXXIX. 1830.

Schizachyrium tenerum Nees, Agrost. Bras. 336. 1829.
Andropogon gracilis Presl, Rel. Haenk. 1:336. 1830. Not *A. gracilis* Spreng., 1825.
Andropogon preslii Kunth, Rév. Gram. 1: Suppl. XXXIX. 1830.
Andropogon leptophyllus Trin. Mém. Acad. St. Pétersb. VI. Math. Phys. Nat. 2:264. 1832.

Sorghum tenerum Kuntze, Rev. Gen. Pl. 2:792. 1891.

Densely tufted perennial; culms usually very slender, erect or reclining, 30–100 cm. long, glabrous; sheaths narrow, keeled, glabrous, the lower longer, the upper shorter than the internodes; ligule about 0.2 mm. long; blades commonly 5–10 cm. long, 1–3 mm. wide, flat or conduplicate, sometimes subinvolute, more or less curved or flexuous, sparsely papillose-hirsute near the base; flowering branches rather few and distant, slender, some of the racemes exserted on long slender peduncles; racemes slender but straight, 2–5 cm. long, the rachis and sterile pedicels with a few long hairs on the sides near the summit, otherwise glabrous; sessile spikelet 4 mm. long, acute or acuminate, scabrous at least toward the tip, the callus rather densely bearded, the awn 7–12 mm. long, geniculate, tightly twisted below the bend; pedicellate spikelet as large as the sessile one, awnless.

Savannas, grassy hills and open slopes, southeastern United States and the West Indies to Argentina.

CHIRIQUÍ: El Boquete, *Hitchcock 8175, 8246;* Cerro Vaca, *Pittier 5361.* COCLÉ: Olá, *Pittier (s. n.).*

Hitchcock 8175 and *Pittier 5361* have spikelets 5–6 mm. long, but the plants are slender and the spikelets are crowded as in *A. tener.*

5. ANDROPOGON VIRGATUS Desv. ex Hamilt. Prodr. Pl. Ind. Occ. 9. 1825.

Hypogynium spathiflorum Nees, Agrost. Bras. 366. 1829.
Andropogon spathiflorus Kunth, Rév. Gram. 1: Suppl. XL. 1830.

Perennial; culms relatively slender, tufted, commonly 1–1.5 m. high, occasionally only 0.5 m., erect, glabrous, usually tinged dull red or brownish; sheaths usually much shorter than the long internodes, compressed, keeled, glabrous; ligule membranaceous, 0.5 mm. long; blades elongate, especially those of the innovations, 2–5 mm. wide, conduplicate, becoming flat, the lower surface glabrous, the upper often more or less villous, the margins obscurely scabrous, sometimes ciliate near the base; inflorescence long and narrow, the slender, relatively short branches closely appressed, bearing numerous solitary racemes 1 cm. long, partly enclosed in small reddish or purplish spathes; spikelets green, 3 mm. long, awnless, the pedicellate as large as the sessile one; first glume scabrous on the keels.

Wet savannas, the West Indies and Costa Rica to Brazil.

CHIRIQUÍ: Dolega, *Hitchcock 8337.*

6. ANDROPOGON CONDENSATUS H.B.K. Nov. Gen. & Sp. 1:188. 1816.

Andropogon microstachyus Desv. ex Hamilt. Prodr. Pl. Ind. Occ. 8. 1825.
Cymbopogon condensatus Spreng. Syst. Veg. 1:289. 1825.
Schizachyrium condensatum Nees, Agrost. Bras. 333. 1829.
Pollinia microstachya Desv. Opusc. 70. 1831.
Andropogon benthamianus Steud. Syn. Pl. Glum. 1:382. 1854.

Rather coarse perennial; culms 1–1.5 cm. high, erect, glabrous; sheaths mostly shorter than the internodes, sometimes overlapping, strongly compressed, keeled, glabrous or scaberulous; ligule firm, truncate, about 2 mm. long; blades 10–20

cm., or even 25 cm., long, 5–10 mm. wide, conduplicate or becoming flat, glabrous, the margins scaberulous; flowering branches numerous from the upper sheaths, ascending or appressed, forming a large, dense, feathery, corymbose, compound inflorescence; racemes solitary, 2–3 cm. long, partly included in the short inconspicuous spathes, the rachis strongly flexuous, the rachis and sterile pedicels long-villous on the sides; sessile spikelet 4 mm. long, narrow, acuminate, the callus shortly bearded, the delicate awn 8–12 mm. long, geniculate, tightly twisted below the bend, loosely twisted above; pedicellate spikelet rudimentary, awnless, or with a short thread-like awn.

Rabo de venado.

Dry open ground and brushy slopes, Mexico and the West Indies to Argentina.

CHIRIQUÍ: El Boquete, *Hitchcock 8185; Killip 4509.* COCLÉ: El Valle, *Allen 769.* CANAL ZONE: Fort Randolph, *Standley 28711;* Toro Point, *Hitchcock 8056;* Fort Lorenzo, *Piper 5947;* between France Field, Canal Zone, and Catival, Colón, *Standley 30421;* Gatún, *Hitchcock 7970;* Barro Colorado Island, *Standley 4114;* Darién Station, *Standley 31570;* Corozal, *Standley 27380;* Ancón Hill, *Killip 4014, 4219; Piper 5265, 5287; Bro. Celestine 81;* Balboa, *Standley 26096.* PANAMÁ: Panamá, *Standley 26804;* Taboga Island, *Allen 112.*

7. ANDROPOGON BICORNIS L. Sp. Pl. 1046. 1753.

Anatherum bicorne Beauv. Ess. Agrost. 128. 1812.
Saccharum bicorne Griseb. Abh. Ges. Wiss. Göttingen 7:266. 1857.
Sorghum bicorne Kuntze, Rev. Gen. Pl. 2:791. 1891.

Coarse perennial; culms 1–2.5 m. high, erect, in rather large clumps, glabrous; sheaths usually shorter than the internodes or the lower ones overlapping, broad, loose, keeled toward the summit, glabrous; ligule 1–1.5 mm. long, minutely erose-ciliate; blades elongate, 2–5 mm. wide, the lower surface glabrous or the midnerve scabrous, the upper pubescent, the margins very scabrous, especially near the tip; flowering branches numerous from the upper sheaths, very compound, forming a very dense, corymbose feathery inflorescence; racemes paired, 2–3 cm. long, partly enclosed or exserted on long slender peduncles from the narrow inconspicuous spathes, the rachis and sterile pedicels densely hairy, the hairs spreading, as much as 5 mm. long; sessile spikelet 3 mm. long, awnless, glabrous; pedicellate spikelet rudimentary, or occasionally larger than the sessile one.

Savannas, fields and open hillsides, sometimes in swamps, southern Mexico and the West Indies to Bolivia and Argentina.

Rabo de Chibo.

BOCAS DEL TORO: Water Valley, *von Wedel 1617.* CHIRIQUÍ: El Boquete, *Hitchcock 8182, 8240, 8258; Maxon 5209; Davidson 699; Woodson & Schery 708.* COCLÉ: between Las Margaritas and El Valle, *Woodson, Allen & Seibert 1714.* CANAL ZONE: Toro Point, *Hitchcock 8050;* Gatún, *Hitchcock 7982;* Monte Lirio, *Maxon 6865;* Bohio, *Maxon 4769;* Frijoles, *Piper 5223;* Barro Colorado Island, *Bailey & Bailey 386; Kenoyer 108;* Gamboa, *Standley 28469;* Empire to Mandinga, *Piper 5238, 5250;* Culebra, *Hitchcock 7938;* Miraflores, *Greenman & Greenman 5199;* between Miraflores and Pedro Miguel, *Pittier 3967;* Ancón Hill, *Killip 4019, 12088;* Balboa, *Standley 25666.* PANAMÁ: Río Pescada, *Bartlett & Lasser 16607;* Chorrera, *Hitchcock 8131;* Río Tapia, *Standley 28068;* Río Tecúmen, *Standley 26643;* Taboga Island, *Hitchcock 8084.*

8. ANDROPOGON GLOMERATUS (Walt.) B.S.P. Prel. Cat. N. Y. 67. 1888.

Cinna glomerata Walt. Fl. Carol. 59. 1788.
Andropogon macrourus Michx. Fl. Bor. Amer. 1:56. 1803.
Anatherum macrourum Griseb. Mem. Amer. Acad. (n. s.) 8:534. 1863.
Andropogon macrourus var. *abbreviatus* Hack. in DC. Monogr. Phan. 6:408. 1889.
Andropogon macrourus var. *corymbosus* Chapm. ex Hack. in DC. Monogr. Phan. 6:409. 1889.
Sorghum glomeratum Kuntze, Rev. Gen. Pl. 2:790. 1891.
Andropogon virginicus var. *corymbosus* Beal, Grasses N. Amer. 2:52. 1896.
Andropogon glomeratus var. *corymbosus* Scribn. U. S. Dept. Agr. Div. Agrost. Bull. 7 (ed. 3):15. 1900.
Andropogon glomeratus var. *abbreviatus* Scribn. U. S. Dept. Agr. Div. Agrost. Bull. 7 (ed. 3):15. 1900.
Andropogon corymbosus Nash in Britton, Man. 69. 1901.
Andropogon corymbosus abbreviatus Nash in Britton, Man. 70. 1901.
Andropogon glomeratus tenuispatheus Nash in Small, Fl. Southeast. U. S. 61. 1903.
Andropogon tenuispatheus Nash, N. Amer. Fl. 17:113. 1912.

Similar in habit and aspect to *A. bicornis;* sheaths sometimes appressed-hirsute on the margins and toward the summit; ultimate branchlets densely hairy below the spathes; sessile spikelet 3-4 mm. long, awned, the awn slender, straight, about 1.5 cm. long; pedicellate spikelet very greatly reduced or usually wanting; the pedicel only present.

Open ground, fields, and grassy banks, often in wet places, southeastern United States and the West Indies to Panama.

CHIRIQUÍ: El Boquete, *Hitchcock 8284, 8289;* Bajo Boquete, *Killip 4567.* CANAL ZONE: Toro Point, *Hitchcock 8038;* Fort Sherman, *Standley 31228;* Colón, *Hitchcock 8033;* Barro Colorado Island, *Kenoyer 262;* Culebra, *Hitchcock 7937;* Balboa, *Standley 25629.*

9. ANDROPOGON VIRGINICUS L. Sp. Pl. 1046. 1753.

Cinna lateralis Walt. Fl. Carol. 59. 1788.
Andropogon dissitiflorus Michx. Fl. Bor. Amer. 1:57. 1803.
Anatherum virginicum Spreng. Pl. Pugill. 2:16. 1815.
Andropogon vaginatus Ell. Bot. S. C. & Ga. 1:148. 1816.
Andropogon tetrastachyus Ell. Bot. S. C. & Ga. 1:150. *pl. 8. f. 4.* 1816.
Andropogon eriophorus Scheele, Flora 27:51. 1844. Not *A. eriophorus* Willd., 1806.
Andropogon louisianae Steud. Syn. Pl. Glum. 1:383. 1854.
Andropogon curtisianus Steud. Syn. Pl. Glum. 1:390. 1854.
Andropogon virginicus var. *vaginatus* Wood, Class-book. ed. 3. 808. 1861.
Andropogon virginicus var. *viridis* Hack. in DC. Monogr. Phan. 6:410. 1889.
Andropogon virginicus var. *tetrastachyus* Hack. in DC. Monogr. Phan. 6:411. 1889.
Sorghum virginicum Kuntze, Rev. Gen. Pl. 2:792. 1891.

Densely tufted perennial; culms erect, 1–1.5 m. high, glabrous; lower leaves crowded in a dense basal cluster, the sheaths flattened, keeled, glabrous, or somewhat hirsute at the summit, the blades elongate, 2–4 mm. wide, the upper surface scabrous, more or less villous toward the base; culm sheaths much shorter than the internodes; ligule about 0.5 mm. long, minutely ciliate; flowering branches from the middle and upper nodes forming a loose inflorescence nearly half the length of the culms; racemes paired, slender, flexuous, partly enclosed in the broad conspicuous spathes, the rachis and sterile pedicels villous with long slender white

hairs; sessile spikelet 3–4 mm. long, bearing a straight slender awn 10–15 mm. long; first glume acuminate, scabrous on the keels near the summit.

Open ground, savannas, hillsides and swamps, southern United States and the West Indies to Panama.

CANAL ZONE: Gatún, *Hitchcock 7971, 7972;* Balboa, *Hitchcock 8013.* PANAMÁ: Chorrera, *Hitchcock 8143.*

10. ANDROPOGON LEUCOSTACHYUS H.B.K. Nov. Gen. & Sp. 1:187. 1816.

Andropogon lanuginosus H.B.K. Nov. Gen. & Sp. 1:187. 1816.
Anatherum domingense Roem. & Schult. Syst. Veg. 2:809. 1817.
Andropogon domingensis Steud. Nom. Bot. 45. 1821.
Andropogon leucostachyus subvar. *subvillosus* Hack. in DC. Monogr. Phan. 6:420. 1889.
Sorghum leucostachyum Kuntze, Rev. Gen. Pl. 2:792. 1891.

Slender perennial; culms in small dense tufts, erect, 25–70 cm. high, glabrous; sheaths narrow, compressed, glabrous, the lower ones crowded; ligule 1–2 mm. long, thin, truncate, minutely erose; blades 5–15 cm. long, or those on the innovations as much as 35 cm. long, 1–3 mm. wide, acute, scaberulous; flowering branches few, long and slender, sparingly branched; racemes paired, sometimes 3, exserted on long slender peduncles, the spathes rather long, but very narrow and inconspicuous; rachis and sterile pedicels slender but straight, densely villous, the spreading hairs commonly 10 mm. long; sessile spikelet 3 mm. long, glabrous, awnless; pedicellate spikelet wanting.

Open, usually dry, fields and hillsides, Mexico and the West Indies to Argentina.

CHIRIQUÍ: El Boquete, *Hitchcock 8240½; Pittier 3324;* Bajo Boquete, *Killip 4578;* David, *Hitchcock 8363, 8364;* Cerro Vaca, *Pittier 5348.* CANAL ZONE: between France Field, Canal Zone, and Catival, Colón, *Standley 30428;* Monte Lirio, *Maxon 6864;* Frijoles, *Standley 31497;* Empire to Mandinga, *Piper 5279;* Culebra, *Hitchcock 7936;* Summit, *Standley 30118;* between Pedro Miguel and Corozal, *Hitchcock 7989;* Corozal, *Killip 4094; Standley 27402;* Ancón Hill, *Killip 4013, 4218, 12108;* Balboa, *Standley 25652.* PANAMÁ: Juan Díaz, *Allen 928;* Chorrera, *Hitchcock 8145;* Río Tecúmen, *Standley 26522.*

11. ANDROPOGON SELLOANUS (Hack.) Hack. Bull. Herb. Boiss. II. 4:266. 1904.

Andropogon leucostachyus subsp. *selloanus* Hack. in DC. Monogr. Phan. 6:420. 1889.

Densely tufted perennial resembling *A. leucostachyus;* culms erect, 45–100 cm. high, solitary or few in each tuft, glabrous; sheaths compressed, keeled, glabrous; ligule 0.5 mm. long; blades conduplicate, becoming flat, 3–5 mm. wide, those of the culm 5–8 cm. long, the uppermost much reduced or wanting, those of the innovations sometimes as much as 20 cm. long; flowering branches long and slender, solitary from the middle and upper sheaths, unbranched; racemes 3–5, exserted from the long and narrow but inconspicuous spathes, densely villous with tawny hairs more than 10 mm. long; sessile spikelet 3–4 mm. long, awnless, glabrous; pedicellate spikelet wanting.

Dry open or wooded hills and banks, British Honduras and the West Indies to Paraguay.

CHIRIQUÍ: David, *Hitchcock 8366.* PANAMÁ: Chorrera, *Hitchcock 8154.*

12. ANDROPOGON ANGUSTATUS (Presl) Steud. Syn. Pl. Glum. 1:370. 1854.

Diectomis laxa Nees, Agrost. Bras. 340. 1829. Not *Andropogon laxus* Willd., 1806.
Diectomis angustata Presl, Rel. Haenk. 1:333. 1830.
Andropogon apricus Trin. Mém. Acad. St. Pétersb. VI. Sci. Nat. 2^1:83. 1836.

Erect slender perennial; culms 50–120 cm. high, glabrous; sheaths much shorter to longer than the internodes, compressed, keeled, auriculate, glabrous; ligule firm, 1–2 mm. long, fused with the auriculate summit of the sheath; blades linear, attenuate, 2–3 mm. wide, glabrous beneath, scabrous above and on the margins; flowering branches few to several from the upper sheaths, forming a loose inflorescence; racemes paired, rarely solitary, about 3 cm. long, at first partly included, finally exserted on long, slender, somewhat flexuous peduncles 5–10 cm. long; rachis and sterile pedicels thickened above, stiffly ciliate with white hairs; sessile spikelet 6 mm. long, the callus densely bearded with white hairs; first glume narrow, obtuse, deeply sulcate, glabrous; second glume compressed, keeled, with a slender divergent awn about 1 cm. long; awn of fertile lemma 3–4 cm. long, rather stout, brown, hispidulous, twice-geniculate, the lower segments tightly twisted, the upper straight; pedicellate spikelet 5 mm. long, the first glume not sulcate, long-hairy on the margins, with a straight slender awn 2–6 mm. long.

Dry savannas at low altitudes, Cuba; Mexico to Brazil.

PANAMÁ: Aguadulce, *Pittier 4883*. CANAL ZONE: Corozal, *Killip 4246;* between Fort Clayton and Corozal, *Standley 29157;* between Panamá and Corozal, *Hitchcock 9190*. PANAMÁ: between Matías Hernández and Juan Díaz, *Standley 32080;* Juan Díaz, *Killip 4225;* Río Tecúmen, *Standley 29392*.

13. ANDROPOGON CONDYLOTRICHUS Hochst. ex Steud. Syn. Pl. Glum. 1:377. 1854.

Andropogon piptatherus Hack. in Mart. Fl. Bras. 2^3:293. 1883.
Sorghum piptatherum Kuntze, Rev. Gen. Pl. 2:792. 1891.
Amphilophis piptatherus Nash, N. Amer. Fl. 17:127. 1912.
Euclasta condylotricha Stapf in Prain, Fl. Trop. Afr. 9:181. 1917.

Annual; culms commonly 1–2 m. long, decumbent or straggling, rooting at the nodes, sending up numerous weak branches, the nodes densely bearded, otherwise glabrous; sheaths usually shorter than the internodes, keeled toward the summit, glabrous on the back, villous in the throat and on the collar; ligule 1 mm. long, membranaceous, with a line of stiff hairs behind it; blades 15–20 cm. long, 4–8 mm. wide, flat, acuminate, sparsely papillose, the margins scabrous; racemes 2–5 cm. long, paniculate, the panicles terminal on the main culm and short branches from the upper sheaths, the panicle branches flexuous, densely villous in the axils; lower pairs of spikelets homogamous; fertile sessile spikelets 4 mm. long, the first glume densely villous, the awn 3–4 cm. long, 2-geniculate, the lower segments brown, tightly twisted, hispidulous, the terminal segment loosely twisted, scabrous; pedicellate spikelets 5–6 mm. long, sparsely papillose-pilose, the keels scabrous.

Brushy slopes, Mexico and the West Indies to Colombia and Venezuela. Also in tropical Africa.

CANAL ZONE: Balboa, *Standley 25264, 26423.*

14. ANDROPOGON SACCHAROIDES Swartz, Prodr. Veg. Ind. Occ. 26. 1788.

Andropogon argenteus DC. Cat. Hort. Monsp. 77. 1813.
Andropogon laguroides DC. Cat. Hort. Monsp. 78. 1813.
Andropogon glaucus Torr. Ann. Lyc. N. Y. 1:153. 1824. Not *A. glaucus* Retz., 1789.
Trachypogon argenteus Nees, Agrost. Bras. 348. 1829.
Trachypogon laguroides Nees, Agrost. Bras. 349. 1829.
Andropogon torreyanus Steud. Nom. Bot. ed. 2. 1:93. 1840.
Andropogon saccharoides var. *laguroides* Hack. in Mart. Fl. Bras. 2^3:293. 1883.
Andropogon saccharoides var. *torreyanus* Hack. in DC. Monogr. Phan. 6:495. 1889.
Sorghum saccharoides Kuntze, Rev. Gen. Pl. 2:792. 1891.
Andropogon saccharoides var. *glaucus* Scribn. Mem. Torrey Club 5:28. 1894.
Amphilophis torreyanus Nash in Britton, Man. 71. 1901.
Holcus saccharoides Kuntze ex Stuck. Anal. Mus. Nac. Buenos Aires 11:48. 1904.
Holcus saccharoides var. *laguroides* Hack. ex Stuck. Anal. Mus. Nac. Buenos Aires 11:48. 1904.
Amphilophis saccharoides Nash, N. Amer. Fl. 17:125. 1912.
Bothriochloa saccharoides Rydb. Brittonia 1:81. 1931.
Bothriochloa laguroides Herter, Revist. Sudamer. Bot. 6:135. 1940; also Pilger in Engler & Prantl, Nat. Pflanzenfam. ed. 2. 14e:160. 1940.

Tufted perennial; culms erect, brittle, 0.5–2 m. high, the nodes usually glabrous but sometimes some of them densely pubescent, but scarcely bearded; sheaths rounded on the back, glabrous; blades flat, acuminate, 10–20 cm., or even 30 cm., long in robust plants, 2–8 mm. wide, scabrous, papillose-hirsute near the base; panicles 5–15 cm. long, dense, white-silky, the usually numerous branches appressed or narrowly ascending; sessile spikelet 4 mm. long, the geniculate twisted awn 1.5–2 cm. long; pedicellate spikelet as long as the sessile, but much narrower, awnless.

Fields, savannas, and grassy slopes, southwestern United States and the West Indies to Argentina.

CANAL ZONE: Balboa, *Hitchcock 8012.* PANAMÁ: Las Sabanas, *Standley 25902;* Chepo, *Killip 4175.*

75. DIECTOMIS H.B.K.

DIECTOMIS H.B.K. Nov. Gen. & Sp. 1:193. *pl. 64.* 1816.

Spikelets in pairs at the nodes of a readily disarticulating rachis, the rachis segments and pedicels narrow at the base, gradually widened and thickened to the summit, densely ciliate-villous on the margins; sessile spikelet laterally compressed, the first glume deeply sulcate, 2-keeled, awnless, the second glume with a slender somewhat divergent awn; fertile lemma shorter than the glumes, 3-nerved, awned from between 2 small teeth, the awn once-geniculate, much longer and stouter than those of the glumes; pedicellate spikelet prominent; first glume broad, flat, many-nerved, rather abruptly acute or acuminate, bearing a slender awn from between the slender teeth of the bifid apex; second glume much shorter and narrower, acuminate.

Erect, branching annuals with solitary racemes somewhat aggregate on the

branches from the upper nodes, forming a narrow but rather loose compound inflorescence.

1. DIECTOMIS FASTIGIATA (Swartz) H.B.K. Nov. Gen & Sp. 1:193. *pl. 64.* 1816.

Andropogon fastigiatus Swartz, Prodr. Veg. Ind. Occ. 26. 1788.

Slender annual; culms erect, commonly 0.5–1.5 m., sometimes as little as 15 cm. high, glabrous; sheaths rounded, glabrous, shorter than the internodes; ligule 5–10 mm., rarely 20 mm., long, acuminate; blades elongate, attenuate, flat or involute, 1–4 mm. wide, scabrous; flowering branches from the upper nodes, ascending, forming a narrow, compound but rather loose inflorescence, the ultimate branchlets somewhat flexuous; racemes 2–6 cm. long, partly enclosed in the spathes; sessile spikelet 5 mm. long, the divergent awn of the second glume about 10 mm. long, that of the fertile lemma 4–5 cm. long, once-geniculate, tightly twisted below the bend; pedicellate spikelet conspicuous, 8 mm. long, minutely ciliate on the margins, the awns 6–10 mm. long; second glume much narrower, 5 mm. long, acuminate.

Dry open ground and thickets, Mexico and the West Indies to Brazil.

CHIRIQUÍ: San Felix, *Pittier 5259.* COCLÉ: Aguadulce, *Pittier 4849, 4877, 4110;* between Paso del Arado and Olá, *Pittier 5018.* CANAL ZONE: between Fort Clayton and Corozal, *Standley 29157a;* between Panamá and Corozal, *Hitchcock 9189;* Ancón, *Hitchcock 22942.* PANAMÁ: between Las Sabanas and Matías Hernández, *Standley 31860;* Nuevo San Francisco, *Standley 30783;* Panamá, *Piper 5245; Standley 26805;* Taboga Island, *Standley 28019.*

76. CYMBOPOGON Spreng.

CYMBOPOGON Spreng. Pl. Pugill. 2:14. 1815.

Spikelets in pairs at each node of the short, paired racemes, those of the lowest pair of one or both racemes alike, sterile, awnless, and similar to the pedicellate spikelets above; sessile fertile spikelets dorsally compressed; first glume flat or grooved, sharply 2-keeled; fertile lemma narrow, awned from between two short lobes, sometimes awnless.

Rather coarse perennials with long narrow blades and large, usually drooping, compound inflorescences of aggregate pairs of racemes subtended by spathes.

1. CYMBOPOGON CITRATUS (DC.) Stapf, Kew Bull. Misc. Inf. 1906:322. 1906.

Densely tufted perennial, seldom if ever flowering in American Tropics; culms erect in large clumps from short rhizomes, commonly 1–2 m. high with numerous leafy sterile shoots; sheaths crowded at the base, elongate, glabrous, the lower ones often of nearly equal length, auriculate, the auricles fused with the margins of the ligule; blades as much as 1 m. long, 5–15 mm. wide, attenuate to a fine point, gradually narrowed to a long almost petiole-like base, scabrous, especially on the margins, the midrib rather strong toward the base; inflorescence 30–60 cm. long, drooping.

Lemon grass; Te limón; Zacate limón.

Cultivated throughout tropical America; introduced from India or Ceylon.

Tea made from the leaves is used for colds, fevers, and various ailments. This plant is the source of part of the lemon-grass oil of commerce.

CANAL ZONE: between France Field, Canal Zone, and Catival, Colón, *Standley 30166*.

77. HYPARRHENIA Anderss.

HYPARRHENIA Anderss. ex Stapf in Prain, Fl. Trop. Afr. 9:291. 1919.

Spikelets arranged in pairs at the nodes of short paired racemes, each pair subtended by a spathe, the lowest pairs alike, awnless, similar to the pedicellate spikelets above; first glume of sessile fertile spikelet flat or rounded, not keeled, or keeled only near the summit; lemma small and narrow, sometimes minutely lobed, with a relatively strong geniculate awn; pedicellate spikelets about as large as the sessile, awnless.

Tall coarse perennials with long narrow blades and rather loose inflorescences, the pairs of racemes somewhat crowded on the branches.

a. Racemes 1 cm. long, purple, with 1 fertile spikelet, the peduncle strongly curved or flexuous, densely papillose-hirsute ..... 1. H. BRACTEATA
aa. Racemes 2–3 cm. long, reddish-brown, with more than one fertile spikelet, usually several, the peduncles straight or only slightly curved, short-pilose ..... 2. H. RUFA

1. HYPARRHENIA BRACTEATA (Humb. & Bonpl.) Stapf in Prain, Fl. Trop. Afr. 9:360. 1919.

Andropogon bracteatus Humb. & Bonpl. ex Willd. Sp. Pl. 4:914. 1806.
Cymbopogon bracteatus Hitchc. Contr. U. S. Nat. Herb. 17:209. 1913.

Perennial; culms in large clumps, erect, 0.5–1.5 m., or sometimes 2 m., high, appressed-hirsute below the nodes; sheaths compressed, keeled, appressed-hirsute at least toward the summit, often densely hirsute all over, the lower ones elongate; ligule membranaceous, 1–2 mm. long; blades elongate, 2–4 mm. wide, flat, or loosely rolled in drying, glabrous or villous, with a bunch of long hairs just back of the ligule; inflorescence narrow and rather dense, usually crowded toward the summit of the culm, the branches usually short-appressed; racemes about 1 cm. long, with 1 perfect spikelet, purple, the pairs protruding from the side of the narrow, hirsute spathes, the peduncle curved or flexuous, densely papillose-hirsute; fertile spikelet 5 mm. long, minutely bi-dentate, sulcate, hispid on the margins at the summit; awns 15–20 mm. long, twice-geniculate, brown, the lower segments tightly twisted, hirsute with pale or yellow hairs; pedicellate spikelets as large as the sessile, the first glume acuminate or awn-pointed.

Fields, wet savannas, and grassy hills, Mexico to Paraguay.

CHIRIQUÍ: El Boquete, *Hitchcock 8173, 8295; Killip 4520*. COCLÉ: Picacho de Olá, *Pittier 5071*.

2. HYPARRHENIA RUFA (Nees) Stapf in Prain, Fl. Trop. Afr. 9:304. 1919.

Trachypogon rufus Nees, Agrost. Bras. 345. 1829.
Andropogon rufus Kunth, Rév. Gram. 1: Suppl. XXXIX. 1830.
Cymbopogon rufus Rendle, Cat. Afr. Pl. Welw. 2:155. 1899.

Perennial; culms erect in large dense clumps 1–2.5 m. high, rarely less, glabrous; sheaths keeled toward the summit, glabrous or papillose-hirsute on the margins toward the summit and in the throat; ligule brown, membranaceous, 2–4 mm. long; blades linear, elongate, 2–8 mm. wide, glabrous or scaberulous, the margins sometimes scabrous; inflorescence 20–40 cm. long, loose and open, composed of several to numerous compound branches from the upper nodes; pairs of racemes terminating the ultimate branchlets, exserted from the narrow inconspicuous spathes, the peduncles commonly 4–6 cm. long, flexuous, pilose; racemes 2–3 cm. long, reddish-brown, the rachis and sterile pedicels densely ciliate with rufous or sometimes yellowish hairs; sessile spikelets 3–4 mm. long; first glume acute or subobtuse, sparsely to densely covered with red hairs; awns 15–20 mm. long, twice-geniculate, brown, the lower segments tightly twisted, hispidulous; pedicellate spikelet as large as the sessile, acute, awnless.

Cultivated as a forage grass, sometimes escaped, Guatemala to Venezuela and Brazil; Tropics of the Old World.

Jaraguá; Zacate jaraguá.

PANAMÁ: Chepo, *Hunter & Allen 80.*

78. SORGHUM Moench

SORGHUM Moench, Meth. Pl. 207. 1794.

Blumenbachia Koel. Descr. Gram. 28. 1802.

Spikelets in pairs, one sessile and fertile, the other pedicellate, usually staminate, the pairs at the nodes of the tardily disarticulating rachis of short, few-jointed, panicled racemes, the terminal sessile spikelet with 2 pedicellate spikelets; glumes of fertile spikelet indurate, the first rounded, somewhat keeled at the summit; fertile lemma awnless or with a short, usually geniculate, twisted awn; pedicellate spikelets herbaceous, lanceolate, the first glume several-nerved, 2-keeled in the upper half.

Coarse annuals or perennials with long narrow or wide blades and open, often large, panicles of short racemes.

a. Plants perennial with strong rhizomes; blades mostly 1–1.5 cm. wide ... 1. S. HALEPENSE
aa. Plants annual; blades wider ... 2. S. VULGARE

1. SORGHUM HALEPENSE (L.) Pers. Syn. Pl. 1:101. 1805.

Holcus halepensis L. Sp. Pl. 1047. 1753.
Blumenbachia halepensis Koel. Descr. Gram. 29. 1802.
Milium halepense Cav. Descr. Pl. 306. 1802.
Andropogon halepensis Brot. Fl. Lusit. 1:89. 1804.
Andropogon sorghum subsp. *halepensis* Hack. in DC. Monogr. Phan. 6:501. 1889.
Andropogon halepensis var. *anatherus* Piper, Proc. Biol. Soc. Washington 28:28. 1915.

Perennial with numerous strong rhizomes; culms erect, usually 1–1.5 m. high, the nodes appressed-pubescent; sheaths usually shorter than the internodes, rounded, glabrous; ligule membranaceous, ciliate, about 2 mm. long; blades elongate, commonly 1–1.5 cm. wide, smooth on both surfaces, the margins somewhat sca-

brous, the midrib prominent; panicles 15–25 cm. long, the branches ascending or spreading, naked below; spikelets 5 mm. long, acute, rather easily and cleanly disarticulating from the pedicel, the first glume indurate, pubescent, the awn, when present, 7–10 mm. long, deciduous.

A common weed in fields and waste places, southeastern United States, Mexico, and the West Indies to Uruguay and Chile. Originally from the Mediterranean region.

Johnson grass.

CANAL ZONE: between Mindi and Colón, *Hitchcock 7948*; Summit, *Standley 30128*; Balboa, *Hitchcock 8002*.

2. SORGHUM VULGARE Pers. Syn. Pl. 1:101. 1805.

Holcus sorghum L. Sp. Pl. 1047. 1753.
Andropogon sorghum Brot. Fl. Lusit. 1:88. 1804.
Andropogon vulgaris Raspail, Ann. Sci. Nat. Bot. 5:307. 1825.
Sorghum dura Griseb. Fl. Brit. W. Ind. 560. 1864.
Sorghum sorghum Karst. Deutsch. Fl. 367. *f. 189*. 1880.
Andropogon sorghum var. *sativus* Hack. in DC. Monogr. Phan. 6:505. 1889.
Andropogon sorghum subsp. *sativus* var. *vulgaris* Hack. in DC. Monogr. Phan. 6:515. 1889.
Andropogon sorghum var. *vulgaris* Hack. ex Hook. f. Fl. Brit. Ind. 7:184. 1896.

Annual; culms coarse, erect, with broad flat blades and small to large, dense, heavy panicles; spikelets ovate, rather densely hairy, awned or awnless.

Cultivated for forage; sometimes escaped. An extremely variable species with numerous horticultural varieties.

Sorghum; Maicillo.

Warm regions of both hemispheres.

CANAL ZONE: Balboa, *Standley 26467*.

SORGHUM VULGARE var. SUDANENSE (Piper) Hitchc. Jour. Washington Acad. Sci. 17:147. 1927.

Andropogon sorghum sudanensis Piper, Proc. Biol. Soc. Washington 28:33. 1915.
Holcus sorghum sudanensis Hitchc. Proc. Biol. Soc. Washington 29:128. 1916.
Sorghum sudanense Stapf in Prain, Fl. Trop. Afr. 9:113. 1917.
Holcus sudanensis Bailey, Gentes Herb. 1:132. 1923.

A tall, more slender grass than S. *vulgare*, with large open panicles, the branches slender, naked below, loosely flowered; spikelets elliptic-lanceolate, usually awned. Similar to S. *halepense*, but annual.

Cultivated in America as a hay and forage plant. Introduced from Africa.

Sudan grass.

PANAMÁ: Las Sabanas, *Killip 4324*.

79. SORGHASTRUM Nash

SORGHASTRUM Nash in Britton, Man. 71. 1901.
Chalcoelytrum Lunell, Amer. Midl. Nat. 4:212. 1915.

Spikelets nearly terete, in pairs, one sessile, the other wanting, only the hairy

pedicel present; glumes subindurate, the first hairy, the margins partly enclosing the second; sterile and fertile lemmas hyaline, ciliate on the margins, the latter deeply lobed, awned from between the lobes, the awn usually geniculate, twisted.

Perennial with long narrow blades and narrow panicles of short few-jointed racemes, usually purplish or brownish, sometimes pale.

a. Plants annual; culms slender at the base, decumbent, rooting at the lower nodes; spikelets mostly 4 mm. long, the articulation oblique, leaving a rather sharp callus; awns 2–4.5 cm. long ..... 1. S. INCOMPLETUM
aa. Plants perennial; culms coarse, erect; spikelets 5–6 mm. long, the callus rounded, blunt, the articulation leaving a cup-shaped pedicel; awns 1–1.5 mm. long ..... 2. S. NUTANS

1. SORGHASTRUM INCOMPLETUM (Presl) Nash, N. Amer. Fl. 17:130. 1912.

Andropogon incompletus Presl, Rel. Haenk. 1:342. 1830.
Andropogon nutans var. *incompletus* Hack. in DC. Monogr. Phan. 6:531. 1889.

Slender annual; culms erect or ascending from a somewhat decumbent base, sometimes rooting at the lower nodes, commonly 20–50 cm., but sometimes as much as 2 m. high, simple or branching from the base, glabrous, the nodes appressed-pubescent; sheaths rounded or keeled toward the summit, glabrous; ligule firm, 0.5–2 mm. long; blades commonly 6–15 cm. long, 2–4 mm. wide, but on larger plants as much as 25 cm. long and 8 mm. wide, pustulose or papillose-roughened, usually pilose on the upper surface, the margins scabrous; panicles 5–20 cm. long, the slender rather distant branches ascending, the secondary branches and peduncles of the short racemes very slender or filiform, flexuous or tortuous, the peduncles glabrous or sparsely covered with long hairs; spikelets 3.5–5 mm. long, the first glume usually truncate, the tip minutely hispidulous, hirsute on the back, sometimes only near the base; rachis joints and pedicels densely ciliate with white or yellowish hairs; awns 2–4.5 cm. long, twice-geniculate, the two lower segments tightly twisted, usually villous, dark brown.

Savannas and grassy fields and hillsides, Mexico to Colombia; tropical Africa.

CHIRIQUÍ: El Boquete, *Hitchcock 8184, 8244;* Río Dupí, *Pittier 5227;* between Cerro Vaca and Hato del Loro, *Pittier 5385.* COCLÉ: Olá, *Pittier 5037.* CANAL ZONE: between Fort Clayton and Corozal, *Standley 29036, 29072.* PANAMÁ: between Las Sabanas and Matías Hernández, *Standley 31850;* Juan Díaz, *Killip 4224;* Pacora River, *Killip 4213;* Río Tecúmen, *Standley 26605, 29394.*

2. SORGHASTRUM NUTANS (L.) Nash in Small, Fl. Southeast U. S. 66. 1903.

Andropogon nutans L. Sp. Pl. 1045. 1753.
Andropogon avenaceus Michx. Fl. Bor. Amer. 1:58. 1803.
Andropogon ciliatus Ell. Bot. S. C. & Ga. 1:144. 1816.
Sorghum nutans A. Gray, Man. 617. 1848.
Sorghum avenaceum Chapm. Fl. South. U. S. 583. 1860.
Chrysopogon nutans Benth. Jour. Linn. Soc. Bot. 19:73. 1881.
Chrysopogon avenaceus Benth. Jour. Linn. Soc. Bot. 19:73. 1881.
Sorghum nutans subsp. *avenaceum* Hack. in Mart. Fl. Bras. 2^3:274. 1883.
Sorghum nutans subsp. *linnaeanum* Hack. in Mart. Fl. Bras. 2^3:276. 1883.
Andropogon albescens Fourn. Mex. Pl. 2:56. 1886.
Andropogon confertus Trin. ex Fourn. Mex. Pl. 2:55. 1886.
Andropogon nutans var. *avenaceus* Hack. in DC. Monogr. Phan. 6:530. 1889.

Andropogon nutans var. *linnaeanus* Hack. in DC. Monogr. Phan. 6:531. 1889.
Chrysopogon nutans var. *avenaceus* Coville & Branner, Rep. Geol. Surv. Ark. 4:234. 1891.
Chrysopogon nutans var. *linnaeanus* Mohr, Bull. Torrey Club 24:21. 1897.
Sorghastrum avenaceum Nash in Britton, Man. 71. 1901.
Andropogon linnaeanus Scribn. & Kearn. ex Scribn. & Ball, U. S. Dept. Agr. Div. Agrost. Bull. 24:40. 1901.
Sorghastrum linnaeanum Nash in Small, Fl. Southeast. U. S. 66. 1903.
Holcus nutans Kuntze ex Stuck. Anal. Mus. Nac. Buenos Aires 11:48. 1904.
Holcus nutans var. *avenaceus* Hack. ex Stuck. Anal. Mus. Nac. Buenos Aires 11:48. 1904.
Chalcoelytrum nutans Lunell, Amer. Midl. Nat. 4:212. 1915.

Perennial; culms densely tufted, erect, 1–2 m. high, glabrous, the nodes appressed-pubescent or hirsute; sheaths rounded, glabrous, usually much shorter than the internodes, auriculate; ligule 1–5 mm. long, the margins fused with the auricles of the sheath; blades elongate, 5–10 mm. wide, the margins scabrous or hispid; panicles 15–30 cm. long, the branches in rather distant fascicles, ascending, slender, straight or somewhat curved, at least the lower ones naked toward the base, glabrous or sometimes villous in the axils; secondary branches and peduncles of the racemes straight or a little flexuous, not tortuous; spikelets 5–6 mm. long, golden to reddish-brown, sparsely hirsute; awns 1–1.5 cm. long, once or obscurely twice-geniculate, tightly twisted, scabrous or minutely hispidulous.

Open grassy hillsides, fields, and plains, United States to Panama.

CHIRIQUÍ: San Felix, *Pittier 5231*. This specimen differs from typical material from the United States in having smaller spikelets and more prominently hispid margins of the blades.

80. TRACHYPOGON Nees

TRACHYPOGON Nees, Agrost. Bras. 341. 1829.

Spikelets in pairs at the nodes of a slender continuous rachis, one nearly sessile, staminate awnless, the other pedicellate, perfect, long-awned; pedicel of the perfect spikelet obliquely disarticulating near the base, forming a sharp bearded callus below the spikelet; first glume of perfect spikelet firm, rounded on the back, several-nerved, obtuse; second glume firm, obscurely nerved; fertile lemma narrow, extending into a stout, twisted, geniculate or flexuous, often plumose awn; sessile spikelet as large as the fertile spikelet, persistent, awnless.

Tufted perennials with terminal racemes, solitary, or few approximate on a short axis.

1. TRACHYPOGON SECUNDUS (Presl) Scribn. U. S. Dept. Agr. Div. Agrost. Circ. 32:1. 1901.

Heteropogon secundus Presl, Rel. Haenk. 1:335. 1830.
Andropogon secundus Kunth, Rév. Gram. 1: Suppl. XXXIX. 1830.
Trachypogon plumosus var. *montufari* subvar. *secundus* Hack. ex Henr. Med. Rijks Herb. Leiden 40:40. 1921.

Perennial; culms densely tufted, erect, 1–1.5 m. high, the nodes densely bearded; sheaths glabrous, auriculate; ligule 5–12 mm. long, firm, the margins

fused with the auricles of the sheath; blades elongate, 2–5 mm. wide, flat or loosely rolled, attenuate, narrowed to an almost petiole-like base, scabrous, especially on the margins; racemes 1–2, 10–20 cm. long; fertile spikelets 10–12 mm. long including the sharp, bearded callus; first glume rather densely pubescent to nearly glabrous; awns 5–7 cm. long, the two lower segments conspicuously plumose.

Dry, grassy or rocky hillsides, Mexico to Panama.

CHIRIQUÍ: El Boquete, *Hitchcock 8188, 8330.* CANAL ZONE: between Panamá and Corozal, *Hitchcock 9195;* Ancón Hill, *Killip 4195; Standley 25198, 26348.* PANAMÁ: Taboga Island, *Hitchcock 8090; Killip 4144; Standley 28008.*

81. ELYONURUS Humb. & Bonpl.

ELYONURUS Humb. & Bonpl. ex Willd. Sp. Pl. 4:941. 1806.

Spikelets in pairs, at the nodes of a tardily disarticulating rachis, one sessile, perfect, the other pedicellate, staminate, similar to the sessile one but smaller, the rachis and pedicels thickened, densely villous; glumes rather firm, rounded on the back, sharply keeled, acuminate, entire or bifid, the margins inflexed, clasping the second glume; second glume acuminate; sterile lemma hyaline, narrow, nearly as long as the glumes; fertile lemma hyaline, awnless, the palea obsolete.

Tufted erect perennials with narrow or involute blades and solitary, terminal, often woolly racemes.

1. ELYONURUS TRIPSACOIDES Humb. & Bonpl. ex Willd. Sp. Pl. 4: 941. 1806.

Perennial; culms densely tufted, erect, 60-100 cm. high, glabrous, sometimes with a pubescent line down one side; sheaths shorter than the internodes, rounded, glabrous, or papillose-pilose or villous toward the summit; ligule membranaceous, minutely ciliate, less than 0.5 mm. long; blades elongate, 1–3 mm. wide, flat or folded, usually villous on the upper surface at the base, the margins scabrous; raceme 5–12 cm. long, the rachis and pedicels densely villous; sessile spikelet 5–8 mm. long, the back glabrous, the margins densely short-ciliate, narrowly winged toward the summit, the tip deeply bilobed, the lobes narrow, acuminate; pedicellate spikelet similar to the sessile but smaller and not as deeply lobed.

Savannas and grassy hillsides, southern United States to Bolivia and Argentina.

CHIRIQUÍ: El Boquete, *Hitchcock 8296.* COCLÉ: Olá, *Pittier 5051.*

ELYONURUS TRIPSACOIDES var. CILIARIS (H.B.K.) Hack. in DC. Monogr. Phan. 6:333. 1889.

Elyonurus ciliaris H.B.K. Nov. Gen. & Sp. 1:193. 1816.

Differing from *E. tripsacoides* only in the pubescent or villous spikelets.

Mexico to Venezuela.

CHIRIQUÍ: El Boquete, *Hitchcock 8254.*

82. ISCHAEMUM L.

ISCHAEMUM L. Sp. Pl. 1049. 1753.

Spikelets in pairs, all alike, perfect, but the pedicellate spikelet not always fruitful, the rachis and pedicels of the disarticulating racemes thickened; first glume indurate and rounded below, flattened, herbaceous and sometimes winged above, often cross-wrinkled or ridged, the narrow margins sharply inflexed; sterile lemma hyaline, as long as the glumes, enclosing a well-developed palea and staminate flower; fertile lemma hyaline, deeply bifid, awned from between the teeth, the awn geniculate, tightly twisted below the bend.

Branching annuals or perennials, often decumbent-spreading, with flat blades and rather thick racemes, digitate or flabellate at the ends of the branches.

a. Plants annual; first glume strongly transversely ridged ..... 1. I. RUGOSUM
aa. Plants perennial; first glume sometimes wrinkled, but not transversely ridged ..... 2. I. CILIARE

1. ISCHAEMUM RUGOSUM Salisb. Icon. Stirp. Rar. 1. *pl. 1.* 1791.

Annual; culms erect or decumbent at the base, rather freely branching from nearly all the nodes, the nodes bearded; sheaths rather loose, keeled toward the summit, glabrous or sparsely papillose-pilose near the summit; ligule 2–3 mm. long; blades mostly 10–15 cm. long, 6–12 mm. wide, acuminate, narrowed toward the base, sometimes petiole-like, the margins very scabrous; racemes in pairs, appressed together and appearing as if one when young, 3–10 cm. long, terminal on the main culm and branches, long-exserted from the upper bladeless sheath, the rachis thick, readily disarticulating, ciliate on the outer edges; spikelets 3–4 mm. long, obtuse, the summit membranaceous, otherwise indurate with 3–5 strong transverse ridges; awns 1.5 cm. long, tightly twisted below, loosely twisted above the bend.

A common weed in fields, clearings, brushy slopes, and waste ground. Introduced in Panama, Cuba, and Jamaica; a native of the Old World.

CANAL ZONE: France Field, *Standley 28587;* Gatún, *Hitchcock 9183;* New Frijoles, *Pittier 6831;* Barro Colorado Island, *Standley 40951;* Darién Station, *Standley 31509;* Tabernilla, *Hitchcock 8381;* Culebra, *Standley 26029;* Summit, *Standley 26914, 27329; D. H. Popenoe 19;* between Miraflores and Pedro Miguel, *Pittier 2506;* between Fort Clayton and Corozal, *Standley 29097;* Balboa Heights, *Killip 4184.* PANAMÁ: Abalaba, *Killip 4268.*

2. ISCHAEMUM CILIARE Retz. Obs. Bot. 6:36. 1791.

Perennial, occasionally stoloniferous; culms decumbent-spreading, rooting at the nodes, branching, commonly 15–40 cm. long, the nodes antrorsely bearded or sometimes glabrous; sheaths loose, glabrous to papillose-pilose, especially on the margins, usually shorter than the internodes, the uppermost bladeless or with a much-reduced blade; blades 3–10 cm. long, 4–8 mm. wide, acuminate, narrowed toward the base, almost petiole-like, pilose on both surfaces, the margins scabrous; racemes 1 or usually 2, 3–5 cm. long, finally spreading, the rachis and sterile pedicels thick, ciliate on the margins, the hairs on the inner margins short, white,

those on the outside margins much longer, yellowish; spikelets 4 mm. long, the first glume acute or mucronate, sometimes minutely lobed, indurate at the base, thinner and prominently nerved toward the summit; awns about 8 mm. long, geniculate, the lower segment tightly twisted, the upper loosely twisted.

Introduced from Asia in Panama and British Guiana. Common in lawns; well established around Balboa.

CANAL ZONE: Ancón, *Hitchcock 22941; Piper 5281; D. H. Popenoe 27;* Balboa, *Standley 26980, 30871.*

83. HACKELOCHLOA Kuntze

HACKELOCHLOA Kuntze, Rev. Gen. Pl. 2:776. 1891.
Rytilix Raf. Bull. Bot. Seringe 1:219. 1830.

Spikelets very dissimilar, in pairs at the nodes of a disarticulating rachis, the rachis segments and pedicels grown together, more or less clasped by the margins of the first glume of the sessile spikelet; sessile spikelet globose, the first glume indurate, alveolate; pedicellate spikelet conspicuous, staminate or sterile, membranaceous, flattened, the first glume broad, rather strongly nerved, acute, the keels winged.

Annual grasses with flat blades and rather numerous short solitary racemes on the flowering branches from the middle and upper nodes.

1. HACKELOCHLOA GRANULARIS (L.) Kuntze, Rev. Gen. Pl. 2:776. 1891.
Cenchrus granularis L. Mant. Pl. 2:575. 1771.
Manisuris granularis Swartz, Prodr. Veg. Ind. Occ. 25. 1788.
Rytilix granularis Skeels, U. S. Dept. Agr. Bur. Pl. Ind. Bull. 282:20. 1913.

Annual; culms erect or ascending, 30–100 cm. high, freely branching, more or less papillose-hispid, especially below the nodes; sheaths short, densely and conspicuously papillose-hispid; blades mostly 5–15 cm. long, 5–12 mm. wide, flat, papillose-hirsute on both surfaces, the margins ciliate; racemes numerous, short, partly enclosed in the subtending spathe; fertile spikelet 1 mm. long, the pedicellate spikelet 2 mm. long.

A common weed in open ground and waste places in tropical regions around the world.

CHIRIQUÍ: El Boquete, *Hitchcock 8294;* David, *Hitchcock 8360.* COCLÉ: Olá, *Pittier 5068.* CANAL ZONE: Culebra, *Hitchcock 7929;* between Miraflores and Pedro Miguel, *Pittier 3965;* Balboa, *Hitchcock 8006; Standley 25288, 26438.* PANAMÁ: Arraiján, *Woodson, Allen & Seibert 1377;* Río Tapia, *Standley 41183;* Chorrera, *Hitchcock 8152;* Taboga Island, *Killip 4153.*

84. MANISURIS L.

MANISURIS L. Mant. Pl. 2:164, 300. 1771.

Spikelets in pairs at the nodes of a thickened, readily disarticulating rachis, one sessile and perfect, the other pedicellate and sterile, the sessile spikelet appressed to the rachis, forming a subcylindrical raceme; first glume of sessile spikelet in-

durate, obtuse, winged, smooth or variously wrinkled or pitted; sterile lemma, fertile lemma and palea hyaline, the fertile lemma awnless; pedicellate spikelet smaller and less indurate than the sessile, sterile.

Slender perennials with narrow flat blades and solitary subcylindrical racemes.

a. First glume of sessile spikelet 3–4 mm. long, smooth or obscurely pitted; flowering branches compound ..... 1. M. AURITA
aa. First glume of sessile spikelet 4–5 mm. long, prominently pitted in lines; flowering branches simple ..... 2. M. RAMOSA

1. MANISURIS AURITA (Steud.) Kuntze, Rev. Gen. Pl. 3[3]:356. 1898.

Rottboellia aurita Steud. Syn. Pl. Glum. 1:361. 1854.

Perennial; culms densely tufted, erect, 1–1.5 m. high, glabrous; sheaths compressed, keeled, glabrous, the lower ones longer, the upper ones shorter than the internodes; ligule less than 0.5 mm. long, membranaceous, minutely ciliate; blades elongate, conduplicate, hirsute on the upper surface near the base, the margins scabrous; flowering branches from the middle and upper nodes, appressed, forming a long, narrow inflorescence; racemes 3–10 cm. long, partly included in the spathes, the rachis and sterile pedicels auriculate at the summit, the auricles prominent or sometimes very small; sessile spikelets 3–4 mm. long, smooth or obscurely pitted, rather broadly winged; pedicellate spikelet narrower but much shorter than the sessile.

Marshes and savannas, Costa Rica to Bolivia and Argentina.

CHIRIQUÍ: El Boquete, *Woodson & Schery 740.* PANAMÁ: Chepo, *Pittier 4649.*

2. MANISURIS RAMOSA Hitchc. Proc. Biol. Soc. Washington 40:88. 1927.

Rottboellia ramosa Benth. ex Hemsl. Biol. Centr.-Amer. Bot. 3:521. 1885. Not *R. ramosa* Cav., 1801.
Apogonia ramosa Fourn. Mex. Pl. 2:63. 1886.
Rottboellia aurita var. *stigmosa* Hack. in DC. Monogr. Phan. 6:311. 1889.
Coelorachis ramosa Nash, N. Amer. Fl. 17:86. 1909.

Differing from the preceding in having fewer, thicker racemes; sessile spikelets 4–5 mm. long, indurate, rather prominently pitted in lines, broadly winged, obtuse, bilobed; pedicellate spikelet commonly much smaller than the sessile, broadly winged.

Low wet ground, Mexico to Colombia.

PANAMÁ: Chepo, Dormisolo, *Pittier 4649.*

85. TRIPSACUM L.

TRIPSACUM L. Syst. Nat. ed. 10. 2:1261. 1759.

Monoecious, the staminate and pistillate spikelets in the same inflorescence; staminate spikelets 2-flowered, in pairs at the nodes of a continuous rachis, one sessile, the other subsessile or pedicellate; glumes membranaceous, equal, many-nerved, the first 2-keeled, the margins rather sharply inflexed; pistillate spikelets solitary on opposite sides on the lower part of the same rachis, sunken in the thickened, hardened disarticulating segments, composed of 1 fertile floret and a sterile

lemma; first glume coriaceous, rounded, the margins nearly enclosing the spikelet, sterile lemma, fertile lemma, and palea hyaline, each successively smaller.

Coarse perennials with usually broad flat blades and 1 to several racemes in terminal and axillary inflorescences.

1. TRIPSACUM LANCEOLATUM Rupr. ex Fourn. Mex. Pl. 2:68. 1886.
Tripsacum lemmoni Vasey, Contr. U. S. Nat. Herb. 3:6. 1892.
Tripsacum dactyloides var. *lemmoni* Beal, Grasses N. Amer. 2:19. 1896.
Tripsacum dactyloides hispidum Hitchc. Bot. Gaz. 41:295. 1906.

Perennial; culms in large, tough, hard clumps 1–2 m. high; blades elongate, attenuate, flat, 0.5–2.5 cm. wide, pubescent or pilose on the upper surface, the margins scabrous; racemes 1 to several; staminate spikelets sessile or subsessile, 5–8 mm. long; pistillate spikelets 5–6 mm. long.

Open ground and brushy slopes, Mexico to Panama.

CANAL ZONE: Sosa Hill, Balboa, *Standley 26430*. This specimen is the basis for the record of *T. dactyloides* in Panama in Hitchcock, Grasses of Central America.

Tripsacum latifolium Hitchc. and *T. fasciculatum* Trin. are reported as cultivated in Panama. The first is a very coarse plant with blades as much as 6 cm. wide, and commonly 2–4, elongate, more or less flexuous racemes, the staminate spikelets sessile or subsessile, mostly 3–4 mm. long. *T. latifolium* is also very coarse with broad blades, the lower ones long-petiolate; some staminate spikelets usually pedicellate.

86. COIX L.

COIX L. Sp. Pl. 972. 1753.

Monoecious, the staminate and pistillate spikelets in the same inflorescence; staminate spikelets 2-flowered in 2's or 3's at each joint of a slender continuous rachis, 2 sessile, the other pedicellate, sometimes wanting; first glume many-nerved, 2-keeled, the keels broadly winged above the middle, the margins narrow and not much inflexed; pistillate spikelets 3 together enclosed in a very hard white or grayish, bead-like involucre or modified bract, the peduncle of the staminate raceme protruding from the orifice at the apex.

Broad-leaved annuals with numerous inflorescences on long stout peduncles, solitary or fascicled in the upper sheaths.

1. COIX LACRYMA-JOBI L. Sp. Pl. 972. 1753.

Culms freely branching, 1 m. or more high; blades as much as 50 cm. long, the upper ones commonly 10–20 cm. long, 2–3.5 cm. wide, rounded or cordate-clasping at the base; staminate part of the inflorescence 2–4 cm. long, the spikelets 8–10 mm. long; beads or sheathing bracts about 1 cm. long, smooth and shining.

Lágrimas de San Pedro; lagrimas de Job.

Introduced from the Old World. Cultivated for ornament, and found as an escape in moist places throughout tropical America.

CHIRIQUÍ: El Boquete, *Davidson 669*. CANAL ZONE: Frijoles, *Standley 31468*; Miraflores Lake, *Allen 171*; between Gamboa and Cruces, *Pittier 3780*; Las Cascadas Plantation, *Standley 29579*; Empire, *Hunter & Allen 768*; Culebra, *Pittier 4777*; *Hitchcock 7917*; Balboa, *Standley 25477*. DARIÉN: Pinogana, *Allen 941*.

87. ZEA L.

ZEA L. Sp. Pl. 971. 1753.

Spikelets unisexual; staminate spikelets 2-flowered, in pairs on one side of a continuous rachis, one nearly sessile, the other pedicellate; glumes membranaceous, acute; pistillate spikelets sessile, in pairs, consisting of 1 fertile and 1 sterile floret, the latter sometimes developed as a second fertile floret; glumes broad, rounded or emarginate at apex; sterile lemma similar to the fertile, the palea present; style very long and slender, stigmatic along both sides well toward the base.

Tall annual, with broad, conspicuously distichous blades, monoecious inflorescences, the staminate flowers in spike-like racemes, these numerous, forming large spreading panicles (tassels) terminating the stems, the pistillate inflorescences in the axils of the leaves, the spikelets in 8–16 or even as many as 30 rows on a thickened, almost woody axis (cob), the whole enclosed in numerous large foliaceous bracts (husks), the long styles (silk) protruding from the top as a silky mass of threads. Only one species in numerous varieties.

1. ZEA MAYS L. Sp. Pl. 971. 1753.

Culms 1–2 m. high; blades as much as 10 cm. wide, recurved; staminate racemes 10–15 cm. long, the central erect, the lateral drooping; pistillate inflorescence or ear and the grains or kernels variable according to the variety.

The original wild form is unknown but was probably a native of the Mexican or Central American highlands. Now commonly cultivated throughout warm and temperate regions.

Corn, maize, or mais.

UNIDENTIFIED NAMES

ERAGROSTIS ACUTIFLORA β. HUMILIOR Presl, Rel. Haenk. 1:277. 1830.

ALOPECURUS LATIFOLIUS Cav., Descr. Pl. 87. 1802.

FLORA OF PANAMA

BY

ROBERT E. WOODSON, JR.

AND

ROBERT W. SCHERY

AND COLLABORATORS

PART II

Fascicle 2

CYPERACEAE (Svenson)

PALMACEAE (Bailey)

CYCLANTHACEAE

ANNALS

OF THE

MISSOURI BOTANICAL GARDEN

Vol. XXX SEPTEMBER, 1943 No. 3

FLORA OF PANAMA

Part II. Fascicle 2

CYPERACEAE

By H. K. Svenson

Grass-like or rush-like herbs, with stems (culms) usually solid and frequently leafless; leaves usually narrow, differing from grasses in the closed sheath; flowers perfect or imperfect, arranged in spikelets, one ordinarily in the axil of each scale (bract); spikelets solitary or in clusters, 1- to many-flowered, the inflorescence frequently surrounded by leaf-like bracts; perianth lacking or of bristles or scales; stamens 1–3, anthers 2-celled, the filaments elongate at maturity; style 2-cleft with the fruit (achene) flattened or lenticular (biconvex) or 3-cleft and the fruit 3-angular.

a. Flowers, at least the pistillate ones, perfect.
  b. Spikelets with not more than 1 or 2 empty basal scales.
    c. Culms leafless; inflorescence glabrous without trace of involucral bracts ..... 3. Eleocharis
    cc. Culms leafy, or, if leafless, with involucral bracts.
      d. Scales of spikelets distichous.
        e. Spikelets with only 1 perfect flower ..... 1. Kyllinga
        ee. Spikelets with 2 to many perfect flowers.
          f. Inflorescence of a single much-flattened spikelet; involucre nearly obsolete ..... 5. Abildgaardia
          ff. Inflorescence of 2 or more spikelets; involucre usually conspicuous ..... 2. Cyperus
      dd. Scales of spikelet spirally imbricated.
        e. Base of style usually persistent as a tubercle; inflorescence more or less pubescent ..... 4. Bulbostylis
        ee. Base of style not persistent.
          f. Flowers without inner scales.
            g. Style-base swollen; bristles lacking ..... 6. Fimbristylis
            gg. Style-base not swollen; bristles frequently present ..... 7. Scirpus
          ff. Flowers with one or more inner scales.
            g. Flowers with 3 broad stipitate scales or modified bristles .. 8. Fuirena
            gg. Flowers with 1 or 2 hyaline scales; no bristles.
              h. Inner scales (2) connate ..... 9. Ascolepis
              hh. Inner scales (2) free and convolute ..... 10. Lipocarpha
  bb. Spikelets with 3 or more of the lower scales empty.
    c. Style 3-cleft (sometimes 2-cleft in *Cladium*).
      d. Large plants with pistillate flower axillary ..... 12. Cladium
      dd. Dwarf sea-side plants with pistillate flower subterminal ..... 11. Remirea
    cc. Style 2-cleft.
      d. Bristles none; spikelets compressed in a terminal involucral cluster ..... 13. Dichromena
      dd. Bristles usually present; spikelets usually paniculate or corymbose ..... 14. Rynchospora
aa. Flowers all imperfect.

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b. Pistillate flower enclosed in a utricle.
c. Utricle enclosing a long uncinate bristle ..... 19. UNCINIA
cc. Utricle enclosing only the pistil ..... 20. CAREX
bb. Pistillate flowers not enclosed in a utricle.
c. Fertile flowers often numerous in each spikelet, lateral, each subtended by a scale.
d. Fertile flower basal ..... 15. SCLERIA
dd. Fertile flower terminal ..... 16. CALYPTROCARYA
cc. Fertile flower, one in each spikelet, terminal.
d. Spikelets in umbellate or paniculate spikes ..... 17. HYPOLYTRUM
dd. Spikelets crowded in a dense head ..... 18. MAPANIA

1. KYLLINGA Rottb.

KYLLINGA[1] Rottb. Descr. & Icon. 12. 1773.

Cyperus (in part) Kuekenthal, Pflanzenr. IV[20]:1-671. 1935-1936.

Annual or perennial, usually glabrous; culms triangular, leafy below, the leaves sometimes reduced to sheaths; inflorescence terminal, of several confluent sessile heads, usually surrounded by a leafy involucre; spikelets of 3–4, 2-ranked scales, only the middle one fertile; bristles none; stamens 1–3; style bifid; achene lenticular. About 45 species, widely distributed in temperate and tropical regions, chiefly in Africa.

a. Leaf-blades absent, the sheaths scarious and colored ..... 1. K. PERUVIANA
aa. Leaf-blades present, the sheaths not colored; involucre prominent.
b. Scales of spikelet translucent, the keel strongly toothed.
c. Annual ..... 2. K. PUMILA
cc. Perennial ..... 3. K. BREVIFOLIA
bb. Scales of spikelet opaque, the keel not toothed ..... 4. K. ODORATA

1. KYLLINGA PERUVIANA Lam. Encycl. 3:366. 1791.

Mariscus aphyllus Vahl, Enum. 2:373. 1806.

Cyperus peruvianus F. N. Williams in Bull. Herb. Boiss. VII. 2:90. 1907; Kuekenthal, Pflanzenr. IV[20]:586. *f. 62.* 1936.

Perennial with thick creeping rhizome and coarse roots, the culms with prominent brown-striate basal sheaths; culms 1.5–4 dm. high, 1.5–2 mm. wide; bracts shorter than the single-headed inflorescence; spikelets numerous; scales ovate, obscurely veined, stramineous to brownish, the keel not toothed; stamens 3; achene narrowly obovate, 1.5 mm. long, dark lucid brown, minutely papillose.

Sandy river banks and beaches, West Indies; Costa Rica to Colombia; tropical Africa.

BOCAS DEL TORO: Laguna de Chiriquí, *Hart 79;* Changuinola Valley, *Dunlap 520.* COLÓN: Santa Isabel, *Pittier 4175.* CANAL ZONE: between Peluca Hydrographic Station and Quebrada Peluca, along Río Boquerón, 70 m., *Steyermark & Allen 17247;* France Field, *Standley 28585;* Isthmus of Panama, *Fendler 349;* Fort Sherman, *Standley 31208.*

2. KYLLINGA PUMILA Michx. Fl. Bor.-Amer. 1:28. 1803.

Cyperus densicaespitosus Mattf. & Kuekenthal, Pflanzenr. IV[20]:597. 1936.

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[1] If *Kyllinga* is to be included under *Cyperus* as Kuekenthal has recently done, then *Lipocarpha*, *Ascolepis* and *Hemicarpha* should also be included under *Cyperus.* Nothing seems to be gained by disturbing the state of these fairly well-defined elements. The genera should probably be arranged in the following order to show the natural relationships: *Cyperus, Kyllinga, Remirea, Ascolepis, Lipocarpha, Hemicarpha.*

Annual, cespitose, 4–40 cm. high, with leaves (2–3 mm. wide) usually shorter than the slender culms; heads 1–3, confluent, ovoid or cylindric, 4–6 mm. long, compressed; scales membranous, pale green, strongly nerved, the keel prominently toothed; stamens 1 or 2; achene elliptic, 1–1.5 mm. long, pale brown, minutely papillose.

Widely distributed, often as a weed in cultivated ground, from New York to Ohio and southward to Argentina; also in Africa.

CHIRIQUÍ: Bajo Mona and Quebrada Chiquero, alt. 1500 m., *Woodson & Schery 557.* PANAMÁ: Chepo, 30 m., *Hunter & Allen 42;* Río Tecúmen, *Standley 29434.* DARIÉN: Boca de Cupe, ca. 40 m., *Allen 887.* CANAL ZONE: Las Cruces Trail, *Standley 29081;* Summit, *Standley 29677;* Ancón Hill, *Standley 25168.*

3. KYLLINGA BREVIFOLIA Rottb. Descr. & Icon. 13. *pl. 4, f. 3.* 1773.

Cyperus brevifolius Hassk. Catal. Hort. Bogor. 24. 1884; Kuekenthal, op. cit. p. 600.

Perennial with rhizomes often elongate; otherwise as in *K. pumila,* from which it is perhaps not specifically distinct. By far the most abundant species in Panama.

Georgia south to Argentina; widely distributed in tropical and temperate regions of the Old World.

BOCAS DEL TORO: Laguna de Chiriquí, *Hart 82.* CHIRIQUÍ: Boquete, alt. 1200–1500 m., *Woodson & Schery 770;* Finca Lérida to Boquete, ca. 1300–1700 m., *Woodson, Allen & Seibert 1155;* "New Switzerland," *Allen 1379.* COCLÉ: El Valle, 800–1000 m., *Allen 106;* between Las Margaritas and El Valle, *Woodson, Allen & Seibert 1773.* COLÓN: Colón, *Rose 23996.* CANAL ZONE: Gamboa, *Pittier 4433;* Balboa, *Standley 30885;* Gatún, *Standley 27276;* Juan Mina, *Piper 3684.*

4. KYLLINGA ODORATA Vahl, Enum. 2:382. 1806.

Cyperus sesquiflorus Mattf. & Kuekenthal, op. cit. p. 591.

Perennial (?) with a short lignose fragrant rootstock, cespitose, culms 1–3 cm. high, slender; leaves shorter than the culms, 2–3 mm. wide; heads 1–3, ovoid or cylindric, 6–12 mm. long; bracts 3–4, spreading to reflexed, up to 6 cm. long; spikelets 3–3.5 mm. long; scales subacute, opaque, the keel smooth and sometimes with yellowish glands.

Wet places. Widely distributed from Georgia and Florida southward to Uruguay; also in tropical Africa and Asia. Apparently rare in Panama.

CHIRIQUÍ: Río Caldera, *Killip 4532.* PANAMÁ: Juan Díaz, *Killip 4057;* Chepo, *Pittier 4465;* Matías Hernández, *Standley 28988.*

Kyllinga pungens Vahl, a plant with strongly developed rhizomes, chiefly of tropical South America, is mentioned by Standley as occurring in Panama, but I have seen no specimens.

2. CYPERUS L.

CYPERUS L. Sp. Pl. 44. 1753; Kuekenthal, Pflanzenr. IV[20]:1-671. 1936.

Annuals or perennials, the culms simple, usually triangular and leafy; inflorescence involucrate in dense spikes or in clusters, capitate or on rays which are often

compound; spikelets flat or subterete, few- or many-flowered, the rachis often winged, the scales concave, 2-ranked; flowers perfect; perianth none; stamens 1–3; style 2- to 3-cleft; achene lenticular or 3-angulate. About 600 species, chiefly in tropical regions.

a. Style 2-cleft.
  b. Surface of achene with vertically elongated cells.
    c. Cell margins whitened in age; scales 2 mm. long, yellow to light brown ..... 1. C. FLAVESCENS
    cc. Cell margins not whitened in age; scales 1 mm. long, deep brown ..... 2. C. PICEUS
  bb. Surface of achene with quadrate cells, frequently with embossed or papillose centers.
    c. Spikelets 4–5 mm. wide ..... 3. C. UNIOLOIDES
    cc. Spikelets 1–3 mm. wide.
      d. Spikelets greenish to yellowish-brown.
        e. Spikelets 1–1.5 mm. wide; dwarf annuals rarely taller than 10 cm. ..... 5. C. POLYSTACHYUS
        ee. Spikelets 2–3 mm. wide; the scale margins strongly hyaline ..... 4. C. ALBOMARGINATUS
      dd. Spikelets black to shining chestnut-brown; 2–3 mm. wide; the scale margins not strongly hyaline ..... 6. C. NIGER
aa. Style 3-cleft.
  b. Culm terete, naked, usually over a meter high ..... 15. C. GIGANTEUS
  bb. Culm more or less trigonous, leafy at least below.
    c. Decurrent scale bases (i.e. wings of the rachilla) becoming corky at maturity; the rachilla breaking into 1-fruited joints ..... 7. C. FERAX
    cc. Rachilla wings not becoming inflated and corky.
      d. Inflorescence of dense, rigid, cylindric spikes.
        e. Spikes usually sessile in a capitate inflorescence ..... 12. C. FLAVUS
        ee. Spikes digitately compound on long rays ..... 10. C. LIGULARIS
      dd. Inflorescence not of dense cylindric spikes.
        e. Spikes loosely cylindric, the spikelets readily falling at maturity.
          f. Scales with a long awn ..... 8. C. PANAMENSIS
          ff. Scales not awned.
            g. Spikes broader at base; achene oblong-elliptic ..... 13. C. HERMAPHRODITUS
            gg. Spikes not broader at base; achene linear-oblong ..... 9. C. TENUIS
        ee. Inflorescence of globose heads or of flattened racemes.
          f. Spikelets small (2–5 mm. long), flattened, in dense glomerulate clusters, mostly on short compound rays.
            g. Achenes yellowish-brown, 1 mm. long ..... 21. C. LUZULAE
            gg. Achenes brick-red, rough, 0.7 mm. long ..... 22. C. SURINAMENSIS
          ff. Spikelets not glomerulate on compound rays.
            g. Spikelets quadrangular, in loose globular heads ..... 11. C. GLOBULOSUS
            gg. Spikelets flattened, in umbellate or racemose clusters.
              h. Ultimate clusters of spikelets forming simple umbels.
                i. Umbels sessile.
                  j. Spikelets green ..... 17. C. COMPRESSUS
                  jj. Spikelets white ..... 20. C. TENERRIMUS
                ii. Umbels on rays.
                  j. Rays short (up to 5 cm.).
                    k. Spikelets brown ..... 24. C. HASPAN
                    kk. Spikelets green ..... 17. C. COMPRESSUS
                  jj. Rays long (mostly 10–20 cm.).
                    k. Culms shorter than the rays; stamen 1 ..... 23. C. SIMPLEX
                    kk. Culms longer than the rays; stamens 2 or 3 ..... 25. C. DIFFUSUS
              hh. Ultimate clusters of spikelets racemose (i.e. axis of the cluster more or less elongate); inflorescence with prominent rays.
                i. Clusters narrow (4 to 5 times longer than broad); inflorescence elongate ..... 14. C. PROLIXUS
                ii. Clusters only slightly longer than broad; inflorescence not elongate.

j. Spikelets purple to dark brown ..... 16. C. ROTUNDUS
jj. Spikelets green, yellow, or yellow-brown.
k. Spikelets dull green; rachilla not winged ..... 19. C. SPHACELATUS
kk. Spikelets yellow to yellow-brown; achenes partly enclosed by the winged rachis ..... 18. C. ESCULENTUS

1. CYPERUS FLAVESCENS L. Sp. Pl. 46. 1753; Kuekenthal, op. cit. p. 398; Fernald, Rhodora 41:529. 1939.

Cyperus Durandii Boeckl. Allg. Bot. Zeitschr. 1:185. 1895.

Annual, the culms tufted, very slender, 2–30 cm. long; leaves 1 mm. wide; bracts longer than the inflorescence; spikelets 5–20 mm. long, 2–3 mm. wide, yellowish, digitate or short-spicate; scales obtuse, closely appressed, 2 mm. long; stamens 3 or 2, the filaments persistent on the rachis; achene lenticular, obovate, 1 mm. long, black with undulate whitened incrustations at maturity.

In wet fields. Tropical and temperate regions of both hemispheres. Type from Europe.

CHIRIQUÍ: El Boquete, *Cornman 2682*. COCLÉ: between Las Margaritas and El Valle, *Woodson, Allen & Seibert 1776;* Aguadulce, near sea-level, *Pittier 4893*. PANAMÁ: between Pacora and Chepo, ca. 25 m., *Woodson, Allen & Seibert 1637;* Chepo, *Pittier 4533;* Chorrera, *Hitchcock 8128;* Las Cruces Trail, *Standley 29083;* Río Tapía, *Standley 28222;* Chivi-Chivi, *Killip 4083;* Nuevo San Francisco, *Standley 30750*.

2. CYPERUS PICEUS Liebm. Dansk. Vid. Selsk. Skr. V. 2:200. 1851; Kuekenthal, op. cit. p. 396.

Cyperus squalidus Liebm. op. cit. p. 199.
Cyperus Tonduzianus Boeckl. Allg. Bot. Zeitschr. 1:185. 1895.

Annual, the culms tufted, slender, 8–30 cm. long; leaves 0.5–1.0 mm. wide; bracts longer than the inflorescence; spikelets 6–12 mm. long, 2 mm. wide, deep brown, digitate or short-spicate; scales obtuse, closely appressed, 1.5 mm. long; stamens 3 or 2, the filaments persistent on the rachis; achene 1 mm. long, as in *C. flavescens*, but slightly shorter, more convex, and lacking the white transverse markings.

In wet places, cited by Kuekenthal from Panama *(Seemann)*. Central Mexico to Brazil and Argentina. Type from southern Mexico (Veracruz and Oaxaca).

3. CYPERUS UNIOLOIDES R. Br. Prodr. Fl. Nov. Holl. 216. 1810; Kuekenthal, op. cit. p. 338.

Cyperus bromoides Link, Jahrb. 3:85. 1820.

Plants with elongate rhizomes; culms slender, 30–90 cm. high; leaves 2–4 mm. wide; bracts long and leaf-like; spikelets 10–18 mm. long, yellowish, short-spicate and on rays or in a single dense cluster; scales 4 mm. long, acute, lucid brown, closely appressed; achene obovoid, 1.5 mm. long, compressed, dull gray, coarsely reticulate.

Wet places, southern California to Argentina; tropics of Old World.

CHIRIQUÍ: El Boquete, alt. 1200–1500 m., *Woodson & Schery 749; Hitchcock 8255; Davidson 698; Cornman 2695*.

4. CYPERUS ALBOMARGINATUS Mart. & Schrad. ex Nees, in Mart. Fl. Bras. 2^1:9. 1842; Kuekenthal, op. cit. p. 359.

Cyperus flavicomus Vahl, Enum. 2: 360. 1806.

Annual; culms 30–90 cm. long; leaves sparse, 5–8 mm. broad, a little shorter than the culm; involucral bracts much exceeding the inflorescence of 4–12 unequal rays; spikelets lax, 10–24 mm. long, the lower scales quickly falling; scales yellow to dull reddish-brown, 2.5 mm. long, with prominent white-hyaline margins; stamens 2 or 3; achene flattened-biconvex, broadly obovate, 2 mm. long, becoming shiny black, and densely papillose.

In wet places, Virginia to Bolivia and Paraguay; Old World tropics. Not recorded from Panama by Standley.

CANAL ZONE: Fort Kobe road, *Woodson, Allen & Seibert 1427*.

5. CYPERUS POLYSTACHYUS Rottb. Descr. & Icon. 39. 1773; Kuekenthal, op. cit. p. 367; O'Neill, Rhodora 42:84. 1940.

Cyperus odoratus L. Sp. Pl. 46. 1753 (in part); Standley, Contrib. U. S. Nat. Herb. 27:88. 1928, and Field Mus. Bot. Ser. 8:247. 1931.
Cyperus paniculatus Rottb. Descr. & Icon. 40. 1773.
Cyperus filicinus Vahl, Enum. 2:332. 1806.
Cyperus Gatesii Torr. and *C. microdontus* Torr. Ann. Lyc. N. Y. 3:255. 1836.
Cyperus fugax Liebm. Dansk. Vid. Selskb. Skr. V. 2:196. 1851.
Cyperus texensis Steud. Syn. Cyp. 9. 1855.

Annual (or rarely perennial with a short rootstock); culms slender, tufted, up to 8 dm. high; leaves 0.5–5 mm. wide, frequently exceeding the inflorescence; bracts elongate; inflorescence 1- to 5-rayed or capitate, the rays not exceeding 5 cm.; spikelets linear to linear-lanceolate, 8–16 mm. long, 1–1.5 mm. wide; scales 1.5–2 mm. long, dull to lucid yellowish-brown; achene biconvex, narrowly elliptic, 1 mm. long, dull yellowish-brown, becoming darker with age, the surface minutely papillose.

A variable plant of tropical and temperate regions from Maine to Argentina; abundant also in the tropics of the Old World.

PANAMÁ: Taboga Island, *Woodson, Allen & Seibert 1506;* Bella Vista, *Killip 4037*.

6. CYPERUS NIGER Ruiz & Pavon, Fl. Peruv. 1:47. 1798; Kuekenthal, op. cit. p. 343.

Cyperus melanostachyus HBK. Nov. Gen. & Sp. 1:207. 1816.
Cyperus diandrus var. *castaneus* S. Wats. Bot. Calif. 2:214. 1880.
Cyperus diandrus var. *capitatus* Britton, Bull. Torrey Club 13:205. 1886.
Pycreus melanostachyus C. B. Clarke, Contrib. U. S. Nat. Herb. 10:446. 1908.

Plants usually rhizomatous, frequently with interlacing culms; culms slender, erect, 10–30 cm. high; leaves sparse, 0.5–2 mm. wide, equaling or shorter than the culms; bracts long and leaf-like; inflorescence capitate, less frequently with 1–3 short rays; spikelets compressed, 4–10 mm. long, 2 mm. wide, black or more frequently castaneous; scales 1.5–2 mm. long, usually closely appressed; achene biconvex, unsymmetrically ellipsoid, 1–1.5 mm. long, deep brown and densely

papillose when mature.

Texas and New Mexico, southward in the mountains to Bolivia and Argentina. In Panama in boggy places, 1200–2000 m. altitude.

CHIRIQUÍ: "New Switzerland," alt. 1800–2000 m., *Allen 1376.*

CYPERUS NIGER var. CASTANEUS (S. Watson) Kuekenthal, from lower levels, is much more abundant. Here seem to belong the plants named *C. lanceolatus (C. Olfersianus, C. Humboldtianus)* in various collections, insofar as I have seen them, nor does Kuekenthal (p. 349) cite *C. lanceolatus* from Panama, a species closely related to *C. Aschenbornianus* in its reddish, somewhat glaucous achenes.

CHIRIQUÍ: Boquete, alt. 1200–1500 m., *Woodson & Schery 748;* Finca Lérida to Boquete, ca. 1300–1700 m., *Woodson, Allen & Seibert 1157, 1134;* El Boquete, *Killip 4534; Cornman 2690.* COCLÉ: between Las Margaritas and El Valle, *Woodson, Allen & Seibert 1723.* PANAMÁ: between Pacora and Chepo, *Woodson, Allen & Seibert 1638* (probably *C. niger* var. *castaneus,* but too young).

7. CYPERUS FERAX L. C. Rich. Act. Soc. Hist. Nat. Paris 1:105. 1792; Kuekenthal, op. cit. p. 615.

Cyperus odoratus L. Sp. Pl. 46. 1753 (in part).
Cyperus speciosus Vahl, Enum. 2:364. 1806.
Dielidium aciculare Schrad. ex Nees in Mart. Fl. Bras. 2^1:55. 1842.
Cyperus Engelmanni Steud. Syn. Cyp. 47. 1855.
Cyperus acicularis Steud. op. cit. 45. 1855.
Torulinium Hayesii C. B. Clarke, Kew Bull. Add. Ser. 8:20. 1908.
Cyperus Hayesii Standley, Jour. Washington Acad. 15:457. 1925.

Annual, the culms stout, 50–100 cm. high, with a bulbous base; leaves 5–12 mm. wide, shorter than the culm; bracts large and leaf-like; inflorescence compound, the loose heads on rays sometimes 2 dm. long; spikelets linear, subterete, 10–20 mm. long (rarely longer), yellow or brownish; scales 2–3 mm. long, striate; rachilla strongly winged, the wings becoming corky and enlarged in age, and the spikelet breaking up into single segments; achene oblong, 1.5–2.5 mm. long, frequently curved, dark brown, finely reticulate or papillose.

In moist or wet soil, often a weed in cultivated ground, at lower levels. Generally distributed in tropical and subtropical regions throughout the world. *C. Hayesii,* described from Panama *(Hayes 424),* is a variant with large spikes (to 4 cm. long) and many-flowered elongate spikelets up to 15 mm. long. Panama specimens, which I have seen, named *C. Ehrenbergii* Kunth (*C. flexuosus* Vahl), sometimes have the achene completely hidden in the corky rachis wings, but are otherwise identical in all details with *C. ferax.* The robust form of *C. ferax,* abundant in Panama, is shown in pl. 1, fig. 3.

BOCAS DEL TORO: Chiriquí Lagoon, *von Wedel 2500;* Maccaw Hill, *von Wedel 5.* COLÓN: Catival, *Standley 30450.* CANAL ZONE: Victoria Fill, near Miraflores Locks, *Allen 1730;* Quebrada La Palma, 70–80 m., *Dodge & Allen 17355* (pathologic specimen); Fort Randolph, *Standley 28750 (Hayesii);* Balboa, *Standley 25637 (Hayesii) 26468;* Culebra, *Hitchcock 8120;* and many other collections. PANAMÁ: Bella Vista, *Killip 12027; Standley 25368;* Matías Hernández, *Standley 28975;* and many other collections. DARIÉN: El Real, ca. 15 m., *Allen 947.*

Cyperus ferax var. acicularis (Schrad.) Kuekenth. Pflanzenr. IV[20]:619. 1936, with remote filiform spikelets, is of rare occurrence in the tropics.

canal zone: Salamanca Hydrographic Station, ca. 80 m., *Woodson, Allen & Seibert 1571*.

8. Cyperus panamensis (Clarke) Britton ex Standl. Jour. Washington Acad. Sci. 15:457. 1925; Kuekenthal, op. cit. p. 498.

Mariscus panamensis C. B. Clarke, Kew Bull. Add. Ser. 8:15. 1908.

Annual, the culms usually stout, 20–50 cm. high; leaves 3–6 mm. wide; bracts large and leaf-like; spikes short-cylindric, sessile or on rays to 6 cm. long; the spikelets greenish-yellow, 3- to 8-flowered, 7–10 mm. long, obsoletely quadrangular; scales obtuse with a long recurving awn at the apex; stamens 3; achene broadly oblong, 2 mm. long, slightly curved, trigonous with concave sides, dark brown at maturity and densely papillose.

At 300 m. or less; type from Panama. Also in Colombia and Ecuador.

canal zone: Balboa, *Standley 26405, 25659, 25237;* Culebra, *Standley 26038;* Las Cruces Trail, *Standley 29144, 29005;* Summit, *Standley 26902.* panamá: near Panamá, *Standley 29706;* Matías Hernández, *Standley 28919;* Taboga Island, *Standley 27952; Cornman 2536.*

9. Cyperus tenuis Sw. Prodr. 20. 1788; Kuekenthal, op. cit. p. 416.

Cyperus caracasanus Kunth, Enum. 2:86. 1837.
Mariscus flabelliformis HBK. Nov. Gen. & Sp. 1:215. 1816; C. B. Clarke, Ill. Cyp. *t. 29, f. 1-2.* 1909.
Cyperus lentiginosus Millsp. & Chase, Field Mus. Bot. Ser. 3:74, with *pl.* 1903.
Cyperus incompletus (Jacq.) Link sensu Standley, Contrib. U. S. Nat. Herb. 27:88. 1928; not *Kyllinga incompletus* Jacq.

Plants with short thick rhizomes, the slender culms 15–30 cm. high, somewhat bulbous at base; leaves mostly basal, 1.5–3 mm. wide; bracts long and leaf-like; inflorescence of 5–9 rays, the spikes loosely cylindric; spikelets greenish or yellowish, 7–10 mm. long, subterete, 3- to 8-flowered, the scales obtuse, striate; achene trigonous, linear-oblong, 1.5 mm. long, densely papillose, dull brown and slightly curved at maturity.

Abundantly distributed in Panama in rocky places and on roadsides, but not clearly distinguishable from slender forms of *C. hermaphroditus*. Central Mexico and the West Indies to southern Brazil; tropical Africa. In the accompanying plate (pl. 1, figs. 1-2) are shown two phases of this variable plant of which the dwarfer form (fig. 1) seems to be generally recognized as typical *C. tenuis*. In *Killip 4156* the spikelets are 2-flowered (with only one achene developing). The form with reflexed spikelets (fig. 2) has been sometimes determined as *C. incompletus*. *M. lentiginosus* (type from Yucatan) lies between the extremes here illustrated.

canal zone: Summit, *Standley 25784, 29676;* Gatuncillo, *Piper 5633;* Balboa, *Standley 25235;* Río Paraiso, *Standley 29922;* Fort Sherman, *Standley 30965;* Barro Colorado Island, *Standley 31449.* panamá: Taboga Island, up to 300 m., *Allen 135; Killip 4164;* Río Tapía, *Standley 28060; Maxon & Harvey 6747;* Río Tecúmen, *Standley 29467.* darién: near mouth of Río Yapé, ca. 20 m., *Allen 360.*

10. CYPERUS LIGULARIS L. Pl. Jamaica Pugill. 3. 1759; Kuekenthal, op. cit. p. 474.
Mariscus rufus HBK. Nov. Gen. & Sp. 1:216. *t. 67.* 1816.

Plants coarse and stout, with very short or no rhizomes, often forming dense clumps, the culms as much as 1 m. high; leaves 5–12 mm. wide, thick, glaucous, usually transverse-lineolate; bracts long and leaf-like; spikes in a compound inflorescence, short and very dense, the reddish-brown spikelets 4–6 mm. long; scales coriaceous, obtuse, striate, closely appressed; achene narrowly obovate, 1.5 mm. long, sharply trigonous (the axial face usually concave), dark brown, with a lightly papillose surface.

Abundant on tropical sea-beaches and frequently inland. Generally distributed in tropical America from Alabama southward; tropical Africa, Madagascar.

BOCAS DEL TORO: Changuinola Valley, *Dunlap 256.* CANAL ZONE: Pedro Miguel, 15–30 m., *Allen 3;* Victoria Fill, near Miraflores Locks, *Allen 1729;* Ancón, *Bro. Celestine 16;* Gorgona, *Hitchcock 8109;* Balboa Heights, *Killip 4022;* Chagres, *Fendler 355;* Monte Lirio, *Maxon 6853.* PANAMÁ: Taboga Island, *Woodson, Allen & Seibert 1494; Killip 4141;* Bella Vista, *Killip 12020;* Saboga I., Pearl Islands, *Miller 1797.*

11. CYPERUS GLOBULOSUS Aubl. Pl. Guian. 1:47. 1775; Kuekenthal, op. cit. p. 510.
Mariscus echinatus Ell. Bot. S. C. & Ga. 1:75. *t. 3, f. 1.* 1821.

Plants slender, with short rhizomes, the culms 15–50 cm. long; leaves 2–4 mm. wide; bracts elongate and leaf-like; spikes subglobose, crowded in a small head or on short rays, the spikelets 4–6 mm. long, crowded, subquadrangular, greenish, 3- to 6-flowered; achene narrowly obovoid, trigonous, 2 mm. long, dark olive-green with a black base, obscurely papillose.

On rocks at sea level. North Carolina to Panama and the West Indies.

CANAL ZONE: Gamboa, *Standley 28312.* PANAMÁ: Bella Vista, *Killip 4038, 4041, 12022.*

12. CYPERUS FLAVUS (Vahl) Nees, Linnaea 19:698. 1847.
Kyllinga cayennensis Lam. Ill. 1:149. 1791.
Mariscus flavus Vahl, Enum. 2:374. 1806.
Cyperus cayennensis (Lam.) Britton, Bull. Dept. Agr. Jamaica 5, Suppl. 1:8. 1907.

Plants with short rhizomes, the culms stout or slender, 20–70 cm. high, with thickened bases; leaves 3–7 mm. wide; involucral bracts long and leaf-like; spikes densely cylindric, 8–25 mm. long, usually sessile, yellowish; spikelets numerous, bearing 1–2 achenes; scales acute and striate; stamens 3; achenes oblong-obovate, trigonous, with concave sides, yellowish-brown, becoming punctulate when mature.

Dry savannas and sandy places. Central Mexico to Argentina; sparingly introduced in southern United States. Kuekenthal has taken up this name instead of *C. cayennensis,* due to the uncertainty of Lamarck's description and because of Nees' affirmation that the Lamarck specimen was *C. Luzulae.* But Vahl, who knew Lamarck's plants, cited both *Kyllinga incompleta* Jacquin and *K. "cajanensis"* Lam. (1791) as synonyms of *Mariscus elatus,* which Kuekenthal, p. 491, treats as

C. coriifolius Boeckl. Kuekenthal, p. 532, has cited *K. incompleta* as *Cyperus flavus* var. *gigas*. *Cyperus incompletus* (Jacq.) Link, listed by Standley in 'Flora of Panama Canal Zone' as a plant with greenish spikelets, contrasted with the reddish spikelets of *C. ligularis*, is probably a variant of *C. tenuis* (cf. pl. 1, fig. 2).

BOCAS DEL TORO: Changuinola Valley, *Dunlap 196*. CANAL ZONE: Summit, *Standley 26967*; Balboa, *Standley 26424*. PANAMÁ: Taboga Island, *Woodson, Allen & Seibert 1512*; Point Chamé, *Hitchcock 8162*.

13. CYPERUS HERMAPHRODITUS (Jacq.) Standl. Contrib. U. S. Nat. Herb. 18:88. 1916; Kuekenthal, op. cit. p. 487. *f. 54*.

Carex hermaphrodita Jacq. Coll. Bot. 4:174. 1790.
Mariscus Jacquinii HBK. Nov. Gen. & Sp. 1:216. 1816.

Plants perennial, with short rhizomes, the culms mostly stout with a thickened reddish base, 15–60 cm. high; leaves 4–8 mm. wide; bracts long and leaf-like; spikes loose, capitate, or on rays to 10 cm. long; spikelets green or yellow, divaricate, quadrangular, 5–10 mm. long, 2- to 7-flowered, the scales obtuse; achene oblong-elliptic, 2 mm. long, trigonous, with the axial face concave, reddish to dull brown, papillose.

In moist soil, Mexico to Argentina. The illustrated spikelet (pl. 1, fig. 1a) is from a large specimen *(Killip 4540)* similar in appearance to Kuekenthal's illustration. This species is questionably distinct from *C. tenuis*, at least in Panama.

CHIRIQUÍ: Finca Lérida to Boquete, ca. 1300–1700 m., *Woodson, Allen & Seibert 1135*; Potrero Muleto to summit, Volcán de Chiriquí, alt. 3500–4000 m., *Woodson & Schery 457*; Bajo Mona, mouth of Quebrada Chiquero, along Río Caldera, *Woodson, Allen & Seibert 1019*; Río Piarnasta, *Killip 4540*. CANAL ZONE: Gatún, *Bro. Heriberto 55*; Summit, *Standley 29608*.

14. CYPERUS PROLIXUS HBK. Nov. Gen. & Sp. 1:206. 1816; Kuekenthal op. cit. p. 146.

Plants perennial, with a thick horizontal rhizome, the culms very stout, 1–1.5 m. high or more; leaves long, 1–2 cm. wide; bracts large and leaf-like; inflorescence large and much branched, elongate, the spikes oblong-elliptic; spikelets 15–20 mm. long, greenish or brownish, the scales lax, acute; achene linear-oblong, 2 mm. long, triquetrous, dull brown and obviously papillose.

River banks and swamps, Mexico to Argentina.

CHIRIQUÍ: Finca Lérida to Boquete, ca. 1300–1700 m., *Woodson, Allen & Seibert 1138*; Boquete, alt. 1200–1500 m., *Woodson & Schery 733*; *Hitchcock 8287*.

15. CYPERUS GIGANTEUS Vahl, Enum. 2:364. 1806; Kuekenthal, op. cit. p. 49, *f. 7*.

Plants large and stout, the culms 1–2 m. high; leaves reduced to basal sheaths; bracts long and leaf-like, 1–2 cm. wide; inflorescence very large, the spikes elongate, lax; spikelets slender, 4–10 mm. long, 8- to 14-flowered, rachilla winged; scales obtuse, stramineous; achene oblong-ellipsoid, trigonous, 1 mm. long, the axial face concave, oblong, yellowish, densely papillose.

The plant, similar in general appearance to the papyrus of the Nile, often forms extensive and dense colonies in open swamps near the coast. Mexico to Argentina.

CANAL ZONE: Monte Lirio, *Maxon 6855.* PANAMÁ: Río Mamoni, below La Capitana, *Pittier 4577.*

16. CYPERUS ROTUNDUS L. Sp. Pl. 45. 1753; Kuekenthal, op. cit. p. 107. *f. 13.*

Perennial, the rhizomes sometimes tuber-bearing; culms slender, 10–60 cm. high, bulbous-thickened at the base; leaves 2–6 mm. wide; bracts usually short; spikes ovate, lax, on rays to 6 cm. long; spikelets linear, 1–2 cm. long, 12- to 30-flowered, rachilla winged; scales purplish, carinate, obtuse, obscurely nerved; achene obovate-ellipsoid, bluntly trigonous, 1.5 mm. long, black, minutely papillose, maturing only infrequently.

Waste places in all tropical and subtropical regions of both hemispheres.

CANAL ZONE: Balboa Heights, *Killip 4235;* Culebra, *Pittier 6683;* Frijoles, *Pittier 6839;* Ancón, *Pittier 3956;* Colón, *Rose 23995;* Barro Colorado Island, *Kenoyer 152;* Gatún, *Standley 27327;* and many other collections. PANAMÁ: Panama City, *Pittier 6715.*

17. CYPERUS COMPRESSUS L. Sp. Pl. 46. 1753; Kuekenthal, op. cit. p. 156.

Plants annual, slender, the culms tufted, 10–40 cm. high; leaves 1.5–3 mm. wide, the sheaths reddish; inflorescence of simple umbels, sessile or less commonly on short rays; spikelets 1–2.5 cm. long, 3–5 mm. wide, 12- to 30-flowered, green, rachilla not winged; achene obovoid, 1.5 mm. long, sharply trigonous, with thickened angles and concave sides, lustrous brown to black.

On sandy shores and wasteland. New York to Brazil and Bolivia; tropics of Old World.

BOCAS DEL TORO: Laguna de Chiriquí, *Hart 75.* CANAL ZONE: Gatún, *Standley 27322;* Frijoles, *Standley 31474;* Isthmus of Panama, *Fendler 352;* Gamboa, *Standley 28470.* PANAMÁ: Bella Vista, *Killip 12038, 4042; Standley 25370;* Las Sabanas, *Standley 25831;* Panamá, *Standley 27682;* Port Chamé, *Hitchcock 8160.*

18. CYPERUS ESCULENTUS L. Sp. Pl. 45. 1753; Kuekenthal, op. cit. p. 116, *f. 14.*
Cyperus fulvescens Liebm. Dansk. Vid. Selsk. Skr. V. 2:22. 1851.

Plants perennial, with long stolons ending in small tubers; the culms 10–60 cm. high; inflorescence of 5–10 lax heads on simple or compound rays; leaves 2–7 mm. wide; bracts leaf-like; the spikelets linear, 5–12 mm. long, yellowish, scales not carinate, many-nerved; achene obovate-oblong, 1.5 mm. long, trigonous, with concave sides, dull gray, minutely reticulate.

In coastal sands and waste places; temperate and tropical areas of both hemispheres. Not recorded by Standley. This species is sometimes cultivated for the tubers under the name *Chufa.*

PANAMÁ: east of Pacora, ca. 25 m., *Woodson, Allen & Seibert 755;* Point Chamé, *Hitchcock 8166.*

19. CYPERUS SPHACELATUS Rottb. Descr. & Icon. 26. 1773; Kuekenthal, op. cit. p. 129.

Annual; culms slender, tufted, 10–60 cm. high; leaves 2–5 mm. wide; bracts long and leaf-like; heads few, loosely ovate, of 5–12 spikelets; spikelets 6–20 mm. long, 2 mm. wide, green or yellowish; scales acute, 2.5 mm. long, striate; achene obovoid, 1.5 mm. long, sharply trigonous, dark lucid brown, smooth.

Sandy places at or near sea level, African and New World tropics.

CANAL ZONE: Gamboa, *Pittier 4434;* Frijoles, *Killip 12177; Cornman 2637;* Balboa, *Standley 26462, 27122,* and other numbers; Culebra, *Standley 25977.* PANAMÁ: Río Chico, *Killip 4177;* Matías Hernández, *Standley 32064;* Juan Díaz, *Standley 30501;* Río Tecúmen, *Standley 26668.*

20. CYPERUS TENERRIMUS Presl, Rel. Haenk. 1:166. 1828; Kuekenthal, op. cit. p. 277.

Cyperus cymbaeformis Liebm. Dansk. Vid. Selsk. Skr. V. 2:208. 1851.

Perennial with bulbous-hardened base; culms slender, 5–25 cm. high; leaves 1–2 mm. wide; bracts 4–8, very long and leaf-like; spikelets compressed, elliptic-ovate, crowded in a small dense whitened head; scales curved, obtuse; achene linear-oblong, 1 mm. long, bluntly trigonous, apiculate, dull brown, obscurely papillose.

Moist savannas. Central Mexico to Colombia.

PANAMÁ: Bella Vista, *Killip 12048.*

21. CYPERUS LUZULAE (L.) Retz. Obs. Bot. 4:11. 1786; Kuekenthal, op. cit. p. 170.

Plants perennial, with short woody rhizomes, the stout culms up to 1 m. high; leaves 3–7 mm. wide; bracts 6–10, long and leaf-like; inflorescence usually simple, the spikelets densely glomerate on short rays; spikelets numerous, ovate, strongly flattened, 3–5 mm. long, 2–3 mm. wide, brownish, 6- to 10-flowered; stamen 1; scales obtuse; achene oblong, 1 mm. long, trigonous, light brown, smooth.

In moist places, at 900 m. or less. Widely distributed in tropical America from the West Indies to Paraguay.

BOCAS DEL TORO: Changuinola Valley, *Dunlap 161;* Laguna de Chiriquí, *Hart 80.* COLÓN: Porto Bello, *Pittier 2466.* CANAL ZONE: near mouth of Río Chagres, *Allen 876;* Chivi-Chivi, *Maxon & Harvey 6590;* Barro Colorado Island, *Kenoyer 150;* Gatuncilla, *Piper 5617;* Corozal, *Piper 5310;* Summit, *Standley 25794;* Balboa, *Standley 25456.* PANAMÁ: Arraiján, ca. 15 m., *Woodson, Allen & Seibert 1343;* Sabanas, *Bro. Paul 86;* Río Tapía, *Maxon & Harvey 6653;* Matías Hernández, *Standley 28973.* DARIÉN: near mouth of Río Yapé, ca. 20 m., *Allen 359.*

22. CYPERUS SURINAMENSIS Rottb. Descr. & Icon. 35. *pl. 6, f. 5.* 1773; Kuekenthal, op. cit. p. 174.

Perennial from short ligneous rhizomes; culms 20–60 cm. high; leaves 2–3 mm. wide; bracts long and leaf-like; inflorescence compound, the spikelets numerous, 4–11 mm. long, 2–3 mm. wide, 30- to 40-flowered, greenish or yellowish, in glomerules, the scales apiculate; achenes minute (0.7 mm. long), ellipsoid, scarcely angled, roughened, brick-red.

In swamps or wet soil, at 1,200 m. or less. Florida and Texas south to Argentina. This species has been frequently confused with *C. Luzulae.*

BOCAS DEL TORO: Chiriquí Lagoon, *von Wedel 2918.* CANAL ZONE: Gorgona, *Hitchcock 8104;* Fort Sherman, *Standley 31170;* Darién, *Standley 31540;* Frijoles, *Killip 12178.* PANAMÁ: Old Panama, *Woodson, Allen & Seibert 1311;* Chepo, 30 m., *Hunter & Allen 65;* Matías Hernández, *Standley 31954.*

23. CYPERUS SIMPLEX HBK. Nov. Gen. & Sp. 1:207. 1816; Kuekenthal, op. cit. p. 225, *f. 25.*

Perennial from weak short rhizomes; culms 4–15 cm. long, slender; leaves long, 3–6 mm. wide; bracts very long and leaf-like; inflorescence simple, the rays mostly 10–20 cm. long; spikelets 1–3 at the end of each ray, 1–2 cm. long, 15- to 40-flowered, strongly compressed, pale; scales viscid, the apex acuminate and incurved; stamen 1; achene obovoid, truncate, obtusely trigonous, 1 mm. long, dull brown, with a whitened waxy covering, densely papillose.

Open forests and roadsides, below 100 m. altitude. Southern Mexico to Brazil and Bolivia.

CANAL ZONE: Río Indio, 70–80 m., *Dodge & Allen 17295;* Barro Colorado Island, *Kenoyer 142;* Gamboa, *Standley 28435.* PANAMÁ: Arraiján, ca. 15 m., *Woodson, Allen & Seibert 1344;* Río Tecúmen, *Standley 29379;* Río Tapia, *Standley 28209;* Matías Hernández, *Standley 28976;* Punta Paitilla, *Piper 5407.*

24. CYPERUS HASPAN L. Sp. Pl. 45. 1753; Kuekenthal, op. cit. p. 247.

Perennial from short slender rhizomes, or sometimes annual; culms weak; leaves mostly short and reduced to sheaths; bracts commonly 2 and shorter than the inflorescence, sometimes elongate; inflorescence usually compound, the spikelets numerous, 5–15 mm. long, 10- to 30-flowered, compressed, reddish- or greenish-brown; scales 1.5 mm. long, obtuse, minutely apiculate; achene minute (0.6 mm. long), obovoid, trigonous, yellow (frequently becoming whitened), with rough granular surface.

In swamps or wet soil, at 1,500 m. or less. Warmer regions of both hemispheres.

CHIRIQUÍ: Boquete, alt. 1200–1500 m., *Woodson & Schery 745;* Finca Lérida to Boquete, ca. 1300–1700 m., *Woodson, Allen & Seibert 1158;* Boquete, *Hitchcock 8259.* COCLÉ: between Las Margaritas and El Valle, *Woodson, Allen & Seibert 1715, 1755;* Aguadulce, *Pittier 4926.* CANAL ZONE: Summit, *Standley 30048.* PANAMÁ: east of Pacora, ca. 25 m., *Woodson, Allen & Seibert 751;* Las Sabanas, *Bro. Heriberto 155;* Chorrera, *Hitchcock 8133;* Chepo, *Pittier 4558;* and many other collections.

25. CYPERUS DIFFUSUS Vahl, Enum. 2:321. 1806; Kuekenthal, op. cit. p. 208.
Cyperus tolucensis HBK. Nov. Gen. & Sp. 1:206. 1816.
Cyperus chalaranthus Presl, Rel. Haenk. 1:177, *t. 32, f. 1.* 1828.

Plants perennial from short rootstocks; culms 30–60 cm. long, the base bulbous; leaves numerous, 4–12 mm. wide; bracts 4–10, long and leaf-like; inflorescence compound, the spikelets on long spreading rays, few or numerous, 1–2 cm. long, 10- to 24-flowered, greenish; scales truncate, with an incurving mucro; achene obovate, 1.5 mm. long, trigonous with concave sides, dark lucid brown, smooth.

In moist or dry soil, usually in forests or thickets, at 1,200 m. or less. Mexico to Argentina; warmer regions of both hemispheres.

BOCAS DEL TORO: *Carleton 188.* CHIRIQUÍ: Puerto Armuelles, alt. 0–75 m., *Woodson & Schery 818.* CANAL ZONE: near mouth of Río Chagres, *Allen 877;* Quebrada La Palma, 70–80 m., *Dodge & Allen 17356, 17354;* between Summit and Gamboa, *Greenman & Greenman 5223;* Gorgona, *Hitchcock 8103;* Darién, *Standley 31588;* Ancón Hill, *Killip 4017.* PANAMÁ: Río La Maestra, 0–25 m., *Allen 33;* Río Tecúmen, up to 30 m., *Hunter & Allen 237;* Taboga Island, *Woodson, Allen & Seibert 1510;* Chepo, *Pittier 4497;* Cana, *Williams 980;* Río Tecúmen, *Standley 26529;* Bella Vista, *Standley 35242.* DARIÉN: Boca de Cupe, ca. 40 m., *Allen 885.*

3. ELEOCHARIS R. Br.

ELEOCHARIS R. Br. Prodr. 1:224. 1810.

Plants annual or perennial, the culms simple, terete or angulate, leafless; spikelet solitary, terminal, erect, few- to many-flowered, not involucrate, the scales spirally imbricate; perianth of 1–6 bristles, frequently wanting; stamens 1–3; style 2- to 3-cleft; achene biconvex or 3-angulate, the style base usually persistent as a tubercle. About 150 species, widely distributed.

a. Scales firm, indurate, scarcely keeled.
  b. Culms acutely 3-angulate above; achenes with strong horizontally elongated cells.
    c. Achene not constricted, gradually prolonged into a cellular beak ..... 1. E. MUTATA
    cc. Achene constricted below the summit into a neck about half the width of the achene ..... 2. E. FISTULOSA
  bb. Culms terete.
    c. Culms transversely septate ..... 3. E. INTERSTINCTA
    cc. Culms not septate ..... 4. E. PLICARHACHIS
aa. Scales thin, keeled or nerved.
  b. Style 2-cleft.
    c. Plants perennial, with rhizomes ..... 5. E. NODULOSA
    cc. Plants annual, with fibrous roots ..... 6. E. CARIBAEA
  bb. Style 3-cleft.
    c. Culms 3–8 mm. thick ..... 7. E. GENICULATA
    cc. Culms less than 2.5 mm. thick.
      d. Achene cancellate ..... 8. E. RETROFLEXA
      dd. Achene smooth or obscurely reticulate.
        e. Plants annual.
          f. Achenes 1 mm. long ..... 9. E. MINIMA
          ff. Achenes 0.5–0.6 mm. long ..... 10. E. NIGRESCENS
        ee. Plants perennial; achenes white or nearly so ..... 11. E. FILICULMIS

1. ELEOCHARIS MUTATA (L.) R. & S. Syst. 2:155. 1817.

Scirpus mutatus L. Pl. Jam. Pug. 6. 1759.

Plants with long stolons, the culms 4–10 dm. high, 3–6 mm. thick, not septate; spikelets 1.5–4 cm. long, 4–6 mm. thick, the scales obtuse, greenish; bristles longer than the achene; style 3-cleft; achene dark brown, faintly cancellate, the tubercle broader than the apex of the achene.

In wet soil. Widely distributed in tropical America and tropical Africa.

CANAL ZONE: Fort Randolph, *Standley 28632;* between Corozal and Ancón, *Pittier 6775;* salt flats, Balboa, *Standley 30892.*

2. ELEOCHARIS FISTULOSA (Poir.) Link in Spreng. Jahrb. 3:78. 1820.

Scirpus fistulosus Poir. in Lam. Encycl. 6:749. 1804.

Culms sharply triangular, 4–6 dm. high; sheaths brown, membranous, rather

loose, pointed at the summit; spikelets 1.5–3.5 cm. long, acute; scales straw-colored or gray, obtuse or somewhat acute, firm, striate; achene 2–2.4 mm. long, obovate, green or light brown, with deeply pitted quadrangular cells; bristles usually exceeding the achene.

In shallow water. Widely distributed in tropical America and in Asia and Africa.

COCLÉ: El Valle de Antón, *Muenscher 12090;* between Las Margaritas and El Valle, *Woodson, Allen & Seibert 1720;* Aguadulce, *Pittier 4928.* PANAMÁ: Matías Hernández, *Standley 28984, 28909;* Las Sabanas, *Standley 25939;* Río Tecúmen, *Standley 26509;* Chorrera, *Hitchcock 8127;* Chepo, *Pittier, 4752, 4602, 4557;* Nuevo San Francisco, *Standley 30757;* Juan Díaz, *Killip 4090.* CHIRIQUÍ: El Boquete, *Hitchcock 8263;* Bajo Boquete, *Killip 4569.*

3. ELEOCHARIS INTERSTINCTA (Vahl) R. & S. Syst. 2:149. 1817.
Scirpus interstinctus Vahl, Enum. 2:251. 1806.

Plants stoloniferous, the culms 4–10 dm. high, about 5 mm. thick; spikelets 2–4 cm. long, 3–5 mm. thick, obtuse, the scales very obtuse, greenish; bristles slightly longer than the achene; style 3- or 2-cleft; achene rough, the body 2 mm. long, the tubercle conic, yellow, the transverse cells prominent; bristles 6, exceeding the achene.

In wet soil. Florida and Texas, southward in the tropics.

COCLÉ: Aguadulce, *Pittier 5719.* CANAL ZONE: Miraflores, mouth of Río Cocoli, *P. White 134;* Río Chagres, 30 m., *Fairchild 2047.* PANAMÁ: east of Pacora, ca. 25 m., *Woodson, Allen & Seibert 748;* Río Tecúmen, *Standley 26516.*

4. ELEOCHARIS PLICARHACHIS (Griseb.) Svenson, Rhodora 31:158. 1929.
Scirpus plicarhachis Griseb. Cat. Pl. Cub. 239. 1866.

Plants stoloniferous, the culms 2–6 dm. high, 2–3 mm. thick; spikelets 2–2.5 cm. long, about 3 mm. thick, the scales greenish; bristles about twice as long as the achene; style 3-cleft; achene minutely reticulate, faintly striate, the tubercle lanceolate, deep brown.

Low grounds in the Canal Zone. Cuba and Mexico to Paraguay.

CANAL ZONE: Darién Station, *Standley 31571;* Frijoles, *Svenson 433;* Barro Colorado Island, *Kenoyer 154.* PANAMÁ: Chepo, 30 m., *Hunter & Allen 87.*

5. ELEOCHARIS NODULOSA (Roth) Schult. in R. & S. Mant. 2:87. 1824.
Scirpus nodulosus Roth, Nov. Pl. Ind. Or. 29. 1821.

Plants with rhizomes, the culms 20–70 cm. long, rather stout, 2–2.5 mm. thick; spikelets 1–2.5 cm. long, fuscous or purplish; bristles equaling the achene, the latter ovoid, greenish-brown, pitted-reticulate, the tubercle small, usually flattened.

In wet soil. Widely distributed in tropical America from Florida and Texas to Argentina.

CHIRIQUÍ: Finca Lérida to Boquete, ca. 1300–1700 m., *Woodson, Allen & Seibert 1154;* Boquete, *Killip 4568; Hitchcock 8257.* COCLÉ: El Valle, 800–1000 m., *Allen 745.* PANAMÁ: Chepo, 30 m., *Hunter & Allen 88;* east of Pacora, ca. 25 m., *Woodson, Allen & Seibert 749;* Matías Hernández, *Standley 28838, 32046;* Las Sabanas, *Standley 25937;*

Bro. Gervais 164; Bro. Heriberto 137; Chepo, *Pittier 4744; Killip 4174;* Juan Díaz, *Killip 4091;* Río Tecúmen, *Standley 26631;* Río Tapia, *Maxon & Harvey 6648.* DARIÉN: El Real, ca. 15 m., *Allen 964.*

6. ELEOCHARIS CARIBAEA (Rottb.) Blake, Rhodora 20:24. 1918.

Scirpus caribaeus Rottb. Descr. & Icon. 24. 1773.
Scirpus geniculatus L. Sp. Pl. 48. 1753 (in part).
Eleocharis capitata R. Br. Prodr. Fl. Nov. Holl. 225. 1810; not *Scirpus capitatus* L.

Culms slender, 5–30 cm. high, tufted, stiff; spikelets ovoid, obtuse, 3–5 mm. long, the scales obtuse, pale yellow, rarely brown, coriaceous, scarious-margined; bristles usually equaling the achene, the latter obovate, black, smooth and shining, the tubercle minute, depressed.

In wet soil. Generally distributed in tropical America, and in the Old World.

COLÓN: Río Indio de Fató, *Pittier 4256;* Colón, *Lehmann 999.* CANAL ZONE: Cristóbal, along French Canal, *Pittier 4236;* Miraflores, *Pittier 2507;* Fort Sherman, *Standley 31138;* Frijoles, *Killip 12175;* Balboa, *Standley 30886;* Darién, *Standley 31505;* France Field, *Standley 28582.* PANAMÁ: Bella Vista, *Killip 12034.*

7. ELEOCHARIS GENICULATA (L.) R. & S. Syst. 2:150. 1817.

Scirpus geniculatus L. Sp. Pl. 48. 1753 (in part), and ed. 2, 71. 1762.
Scirpus elegans HBK. Nov. Gen. & Sp. 1:226. 1816.

Rhizomes often coarse, the culms 3–10 dm. high, transversely septate, terete; spikelets 1–3 cm. long, 5–9 mm. thick, brown, the scales acutish; bristles equaling or longer than the achene, which is ellipsoid, biconvex to trigonous, granular, yellow-brown, the tubercle usually flattened, dark brown, elongate.

In wet soil, often in marshes or along stream banks; 1500 m. Generally distributed in tropical America, from central Mexico and the West Indies to Argentina.

CHIRIQUÍ: Finca Lérida to Boquete, ca. 1300–1700 m., *Woodson, Allen & Seibert 1159;* Boquete, alt. 1200–1500 m., *Woodson & Schery 706;* El Boquete, *Hitchcock 8290; Davidson 646.* COCLÉ: El Valle de Antón, *Muenscher 12089, 12091;* Aguadulce, *Pittier 4964.* CANAL ZONE: Corozal Road, *Killip 4117;* Mamei, *Pittier 2253, 3794;* Gorgona, *Hitchcock 8108;* Juan Mina, *Piper 5699.* PANAMÁ: east of Pacora, ca. 25 m., *Woodson, Allen & Seibert 746;* Chepo, *Pittier 4672;* Nuevo San Francisco, *Standley 30760.*

8. ELEOCHARIS RETROFLEXA (Poir.) Urban, Symb. Antill. 2:165. 1900.

Scirpus retroflexus Poir. in Lam. Encycl. 6:753. 1804.

Rhizomes filiform; culms capillary, 2–20 cm. long; spikelets 3–4 mm. long, containing 1–4 achenes, green, sometimes spotted with purple, the scales acutish; bristles equaling the achene, which is obovoid, trigonous, white, coarsely cancellate, the tubercle pyramidal.

In moist soil, the matted plants forming pure colonies in wet fields or pastures. Abundant in the American tropics, from Alabama, Cuba, and southern Mexico to Colombia and Brazil.

BOCAS DEL TORO: Chiriquí Lagoon, *von Wedel 2724.* CHIRIQUÍ: El Boquete, alt. 1200–1500 m., *Woodson & Schery 756; Maxon 5380; Killip 4533; Davidson 572; Cornman 2683.* COCLÉ: El Valle, 800–1000 m., *Allen 107.* COLÓN: Porto Bello, *Pittier 2453.* CANAL ZONE: between Peluca Hydrographic Station and Quebrada Peluca, along Río

Boqueron, 70- m., *Steyermark & Allen 17267;* Culebra, *Standley 25996;* vic. France Field, *Standley 30452.* PANAMÁ: Río Tecúmen, *Standley 26657;* Nuevo San Francisco, *Standley 30759;* Chorrera, *Killip 4334;* Río Pacora, *Killip 4211;* Panamá, *Standley 26872;* Chepo, *Pittier 4601, 4559.*

9. ELEOCHARIS MINIMA Kunth, Enum. 2:139. 1837.

Eleocharis Durandii Boeckl. Allg. Bot. Zeitschr. 1896:34. 1896.

Dwarf annual, the capillary culms 3–7 cm. high; spikelets 2–4 mm. long, ovate, usually many-flowered, the scales acute, dark brown; bristles inconspicuous, shorter than the achene, which is ovate, sharply trigonous, pale brown to olive, the tubercle trigonous.

Abundant in damp places in tropical America, from Texas and Alabama to Argentina.

COCLÉ: bogs between Las Margaritas and El Valle, *Woodson, Allen & Seibert 1723* fragments, cf. *C. niger*). CANAL ZONE: Corozal, *Standley 29082.* PANAMÁ: Juan Díaz, *Standley 30515;* Matías Hernández, *Standley 28995, 32030;* Río Tecúmen, *Standley 26714.*

10. ELEOCHARIS NIGRESCENS (Nees) Steud. Syn. Cyp. 77. 1855.

Scirpidium nigrescens Nees in Mart. Fl. Bras. 2^1:97. 1842.

Dwarf annual, or perennial, culms 3–7 cm. high; spikelets 2–5 mm. long, ovate, many-flowered; achene semi-translucent brown to opaque white with costulate angles, minute (0.5–0.6 mm. long), the tubercle trigonous.

Damp places. South Carolina to Brazil; tropical Africa and Madagascar.

COCLÉ: Natá, ca. 50 m., *Allen 818.* PANAMÁ: vic. Juan Franco Race Track, *Standley 27816.*

11. ELEOCHARIS FILICULMIS Kunth, Enum. 2:144. 1837.

Scirpus sulcatus Roth, Nov. Pl. Ind. Or. 30. 1821; not Petit-Thouars, 1811.
Limnochloa calyptrata Liebm. Dansk. Vid. Selsk. Skr. V. 2:56. 1849.
Eleocharis calyptrata Steud. Syn. Cyp. 81. 1855.
Eleocharis Rothiana Boeckl. Flora 43:3. 1860.

Rhizomes short, the culms tufted, 10–30 cm. high; spikelets 4–7 mm. long, many-flowered, obtuse, fuscous or rarely purplish, the scales obtuse or emarginate; bristles shorter than the achene, which is trigonous, obovoid, smooth, the tubercle trigonous, short and broad.

Wet soil, central Mexico and Cuba to Argentina.

CHIRIQUÍ: Finca Lérida to Boquete, ca. 1300–1700 m., *Woodson, Allen & Seibert 1156;* El Boquete, *Hitchcock 8256; Cornman 2685, 2688.* COCLÉ: between Las Margaritas and El Valle, *Woodson, Allen & Seibert 1718, 1725;* Aguadulce, *Pittier 4896, 4899;* El Valle, 800–1000 m., *Allen 98.* CANAL ZONE: Las Cruces Trail, *Standley 29168;* Río Pedro Miguel, *Standley 30045.* PANAMÁ: Chepo, 30 m., *Hunter & Allen 86;* between Pacora and Chepo, 25 m., *Woodson, Allen & Seibert 1634;* Chorrera, *Hitchcock 8125;* Matías Hernández, *Pittier 6916;* Nuevo San Francisco, *Standley 30763;* Juan Díaz, *Killip 4093;* Las Cruces Trail, *Cornman 2620, 2588.*

4. BULBOSTYLIS[1] Kunth

[1] There is no doubt that Kunth's use of *Bulbostylis,* Enum. 2:205, came from the manuscript of Nees. As I have already mentioned in discussing *Eleocharis albibracteata* in Rhodora 31:179. 1929, Kunth had access to Nees' manuscript. And on p. 81 of Fl. Bras. (2^1. 1842) Martius definitely says:

Bulbostylis Kunth, Enum. 2:205. 1837, sub *Isolepis;* Nees ex Martius, Fl. Bras. 2^1:80. 1842; not *Bulbostylis* Steven (1814) nor DC. (1836).

Stenophyllus Raf. Neogen. 4. 1825.
Oncostylis Martius, Fl. Bras. 2^1:80. 1842.

Pubescent annuals or perennials with slender culms, leafy below, the leaves narrowly linear or filiform with ciliate or pubescent sheaths; spikelets umbellate, capitate or solitary, sometimes appearing lateral on the culm, with 1 or more subtending bracts or sterile scales; scales pubescent, spirally imbricated, usually deciduous; style 3-cleft, with an enlarged base (tubercle) sometimes constricted below and usually persistent on the apex of the achene; perianth lacking; achene trigonous, rarely lenticular, with longitudinally elongate cells and frequently with a papillose-roughened surface; stamens 1–3. About 90 species, chiefly in dry sandy places, in tropics of both hemispheres.

a. Spikelet 1 ..... 1. B. PARADOXA
aa. Spikelets few or many.
  b. Slender annual ..... 2. B. TENUIFOLIA
  bb. Perennial.
    c. Achenes elongate; culms thickened ..... 3. B. PAPILLOSA
    cc. Achenes obovate; culms filiform ..... 4. B. JUNCIFORMIS

1. Bulbostylis paradoxa (Spreng.) Lindman, K. Sv. Vet.-Akad. Handl. Bihang 26^9:17. 1900.

Schoenus spadiceus HBK. Nov. Gen. & Sp. 1:227. *t. 69, f. 1.* 1816; not *Eriocaulon spadiceum* Lam. Encycl. 3:277. 1789; not *Schoenus spadiceus* Vahl, Enum. 2:210. 1806.
Schoenus paradoxus Spreng. Syst. 1:190. 1825.

Perennial with a thickened vertical caudex clothed by persistent leaf-bases, the resulting fire-resistant structure often 6 cm. long and 3 cm. thick; culms 4–12, borne at the apex of the caudex; leaves capillary to filiform, flattened, often recurved, shorter than or equaling the culms, the sheaths densely lanate, 4–10 cm. high, thickened, striate; inflorescence a single terminal obovate spikelet 7–10 mm. long, 5 mm. wide, becoming broader at maturity by expansion of the perianth-like outer involucral bracts; scales lanceolate, rigid, long-cuspidate, lanate-fimbriate; mature achenes obovate to pyriform, obtusely trigonous, 1.5 mm. long, dark brown, undulate; tubercle dark brown, depressed-conic.

Pinelands and dry prairies. Cuba, and from Panama south to Brazil.

VERAGUAS: between Cañazas and the foot of the Cordillera Central, headwaters of Río Cañazas, 300–600 m., *Allen 151.* COCLÉ: Penonomé, *Williams 304.* CANAL ZONE: R. Azote Caballo, 66–70 m., *Dodge, Steyermark & Allen 16851.*

"*Kunth. En. II. 205 (cum Isolepide tanquam Sect. III.) Bulbostylis N. ab E. MSS.—Isolepidis spec. N. ab E. . . . —Scirpis spec. Linn. et Auctt.* (Nomen genericum *Bulbostylis* a Neesio inditum et in generum dispositione (supra 72) positum mutavi in *Oncostylis,* quod *Bulbostylis* jam a De Candollio *(Prodr. V. 138)* usurpatum sit. Mart.)" [The generic name *Bulbostylis* given by Nees and inserted in the arrangement of genera (p. 72) I have changed into *Oncostylis* because *Bulbostylis* has already been used by De Candolle. (Martius)]. *Bulbostylis* Kunth, published only as a section of *Isolepis* and not as a genus, was conserved by the Committee on Nomenclature (cf. Rhodora 40:392. 1938). Since Kunth's name has been conserved as a genus it seems that further argument about the exact place of publication is unnecessary.

2. BULBOSTYLIS TENUIFOLIA (Rudge) Macbride, Field Mus. Bot. Ser. 11:5. 1931.
Scirpus tenuifolius Rudge, Pl. Guian. 18:*t. 22.* 1805.

Annual; culms capillary, 0.5–2 dm. high, glabrous; leaves capillary, shorter than culms, usually glabrous; spikelets narrowly ovate, 3–6 mm. long, dark brown; achene trigonous, obovate, 0.6–0.8 mm. long, usually finely papillose, grayish-brown, often with concave sides.

Northern South America; of scattered distribution in West Indies, Mexico, and Central America.

CHIRIQUÍ: El Boquete, *Killip 4507.* CANAL ZONE: Ancón Hill, *Standley 26353; Cornman 2520.* PANAMÁ: Las Sabanas, *Standley 25907;* Nuevo San Francisco, *Standley 30712.*

3. BULBOSTYLIS PAPILLOSA Kuekenthal in Fedde, Rep. Sp. Nov. 23:198. 1926.

Culms bulbous-thickened at base, 5–10 dm. high, glabrous, generally inflated; leaves much shorter than culms, the sheaths cinnamon-brown; inflorescence a congested compound umbel; spikelets 7–12 mm. long, lucid reddish-brown; achene brown, oblong, 1 mm. long, with a densely papillose surface.

West Indies; Mexico to Bolivia and Brazil.

CHIRIQUÍ: El Boquete foothills, 1000–1300 m., *Hitchcock 8181, 8323; Cornman 2677.* CANAL ZONE: Ancón Hill, *Killip 4121, 12089; Standley 25196, 26350.* PANAMÁ: Taboga Island, *Woodson, Allen & Seibert 1461; Standley 28051.*

4. BULBOSTYLIS JUNCIFORMIS (HBK.) Lindman, K. Sv. Vet.-Akad. Handl. Bihang 26^{9}:19. 1900.
Isolepis juncifórmis HBK. Nov. Gen. & Sp. 1:222. 1816.

Culms bulbous-thickened at base, 2–4 dm. high, filiform, glabrous; leaves setaceous, shorter than the culms; bracts mostly shorter than the umbellate inflorescence; spikelets 4–6 mm. long, dark brown, numerous in each glomerule; scales castaneous to dull reddish-brown; achene obovate, trigonous, 0.7–0.9 mm. long, truncate at apex, brown to bluish-gray.

Dry soil at varying altitudes on the mainland. Cuba, Honduras, and northern South America.

COCLÉ: Natá, alt. 50 m., *Allen 848.* PANAMÁ: Chorrera, *Hitchcock 8126.*

5. ABILDGAARDIA Vahl

ABILDGAARDIA Vahl, Enum. 2:296. 1806.

Glabrous perennials, with slender culms, narrow setaceous basal leaves, flattened usually solitary spikelets, and an involucre of 1 bract; scales imbricated in two rows, keeled and deciduous; bristles none; stamens 1–3; style pubescent, deciduous, with a somewhat swollen base; achenes trigonous. About 15 species, chiefly in the Old World tropics. Differs from *Bulbostylis* in the glabrous, distichous scales, and the stalked tuberculate achenes with isodiametric cells.

1. ABILDGAARDIA MONOSTACHYA (L.) Vahl, Enum. 2:296. 1806.
Cyperus monostachyus L. Mant. 180. 1771.
Fimbristylis monostachya Hasskarl, Pl. Jav. Rar. 61. 1848.

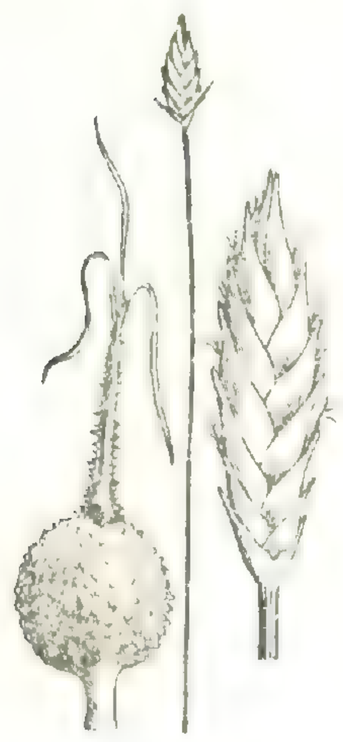


Fig. 32
Abildgaardia monostachya

Culms slender, tufted, 2–4 dm. high; leaves setaceous, 0.5 mm. wide, half as high as the culms, the involucral bract shorter than the spikelet; spikelet ovate-lanceolate, 1–1.5 cm. long, many-flowered, the lower scales readily deciduous; scales greenish-white, strongly keeled; style with 3 short branches; achenes 2–2.5 mm. long, yellowish-white, tuberculate, prominently stalked.

An abundant species of wet grassy places, in the tropics of both hemispheres.

PANAMÁ: Las Sabanas, *Standley 25906, 40784;* Panama Golf Club, *Higgins 201.*

6. FIMBRISTYLIS Vahl

FIMBRISTYLIS Vahl, Enum. 2:285. 1806.

Plants annual or perennial, the culms leafy below; spikelets usually capitate or on short rays, sometimes solitary, with a leafy involucre; scales concave, usually spirally imbricate, all fertile; perianth none; stamens 1–3; style 2- to 3-cleft, usually with an enlarged deciduous base; achene lenticular, biconvex, or 3-angulate, with quadrangular or horizontally elongate cells. About 125 species of moist soils, chiefly of the Old World tropics.

a. Style branches 2; achenes lenticular; style frequently fringed below the branches.
  b. Achenes longitudinally striate; plants frequently annual ..... 1. F. ANNUA
  bb. Achenes not longitudinally striate.
    c. Spikelets in a dense congested inflorescence ..... 2. F. SPATHACEA
    cc. Spikelets mostly on elongate rays.
      d. Scales puberulent at the base; mature achenes gray to black ..... 3. F. SPADICEA
      dd. Scales appressed-pubescent at the apex ..... 4. F. FERRUGINEA
aa. Style branches 3; achenes trigonous; style not fringed below the branches.
  b. Spikelets 2–4 mm. long, very obtuse ..... 5. F. MILIACEA
  bb. Spikelets about 6 mm. long, acute ..... 6. F. COMPLANATA

1. FIMBRISTYLIS ANNUA (All.) R. & S. Syst. 2:95. 1817.

Scirpus diphyllus Retz. Obs. Bot. 5:15. 1789.
Fimbristylis laxa Vahl, Enum. 2:292. 1806.
Fimbristylis polymorpha Boeckl. Vid. Medd. Kjobenhavn 1869:141. 1870.

Annual or perennial, glabrous or pubescent; culms 5–60 cm. high; leaves shorter than the culms; inflorescence loose and open, the spikelets numerous, 5–10 mm. long, solitary, acute, brown or castaneous; style 2-fid, prominently fimbriate; achenes obovoid, biconvex, white or stramineous, with about 10 rows of horizontally-elongated cells on each face and about 10 longitudinal ribs formed by the cell margins.

This species varies greatly in size, the perennial phase being var. *diphylla* Kuekenthal in Fedde, Rep. Spec. Nov. 23:196. 1926. It is one of the most widely spread plants in the world, in dry or moist habitat, at low altitudes in both tem-

perate and tropical regions. There are 400 or more synonyms.

BOCAS DEL TORO: Changuinola Valley, *Dunlap 185;* Chiriquí Lagoon, *von Wedel 1255; Hart 68.* COCLE: Natá, alt. 50 m., *Allen 845;* between Las Margaritas and El Valle, *Woodson, Allen & Seibert 1724, 1775.* COLÓN: Porto Bello, *Pittier 2455.* CANAL ZONE: Balboa Heights, *Killip 4236;* Darién, *Standley 31572;* Summit, *Standley 29507, 30049, 30054;* Gamboa, *Standley 28471;* Frijoles, *Standley 27647;* Gatún, *Standley 27277;* Culebra, *Pittier 3791;* between Fort Clayton and Corozal, *Standley 29079;* and many other collections. PANAMÁ: east of Pacora, ca. 25 m., *Woodson, Allen & Seibert 742, 745;* between Pacora and Chepo, ca. 25 m., *Woodson, Allen & Seibert 1633, 1636;* Nuevo San Francisco, *Standley 30726;* Río Tapia, *Standley 28821;* Río Tecúmen, *Standley 29404;* Taboga Island, *Killip 4151;* Juan Díaz, *Killip 4059, 4052;* Matías Hernández, *Standley 28900;* Panamá, *Standley 27822;* Punta Paitilla, *Standley 26299;* Las Sabanas, *Standley 25905;* Chepo, *Pittier 4528;* Isthmus of Panama, *Fendler 345.*

2. FIMBRISTYLIS SPATHACEA Roth, Nov. Pl. Ind. Or. 24. 1821.

Scirpus glomeratus Retz. Obs. Bot. 4:11. 1876; not L. Sp. Pl. 52. 1753.
Fimbristylis glomerata Urban, Symb. Antill. 2:166. 1900; not Nees, 1834.

Glabrous perennial, with short thick rhizomes, the culms stout, 10–40 cm. high; leaves narrow, stiff; spikelets numerous, crowded, 3–6 mm. long, obtuse, brownish; achene obovate, 0.8 mm. long, becoming purplish-black at maturity, the rugose surface minutely reticulate.

Atlantic coast. Widely distributed on tropical beaches of both hemispheres.

BOCAS DEL TORO: without locality, *von Wedel 501.* CANAL ZONE: Fort Sherman, *Standley 31205; Piper 5884;* France Field, *Standley 28579;* Cristobal, *Pittier 4234.*

3. FIMBRISTYLIS SPADICEA (L.) Vahl, Enum. 2:294. 1806.

Scirpus spadiceus L. Sp. Pl. 51. 1753.
Scirpus castaneus Michx. Fl. Bor.-Amer. 1:31. 1803.
Scirpus puberulus Michx. op. cit.

Glabrous to pubescent perennial, often with elongate rhizomes, the culms 3–10 dm. high; leaves narrow, stiff, the bases indurate and castaneous or blackish; spikelets few or numerous, 1–1.5 cm. long, the scales obtuse, glabrous or puberulous, apiculate, dark brown with paler veins imbedded in the tissue; achene biconvex, obovate, with deep-pitted horizontally elongated cells, and narrowed at the base to a minute purplish annulus.

Sea beaches or tidal flats, often extending inland. Temperate and tropical America.

COLÓN: Viento Frio, *Pittier 4139.* SAN BLAS: Puerto Obaldía, *Pittier 4401.* CANAL ZONE: Balboa, *Standley 25622;* Fort Randolph, *Standley 28752, 30880;* Victoria Fill, near Miraflores Locks, *Allen 1703, 1728;* Pedro Miguel, 15–30 m., *Allen 4;* Cristobal, *Pittier 4235;* Corozal, *Killip 4338.*

4. FIMBRISTYLIS FERRUGINEA (L.) Vahl, Enum. 2:291. 1806.

Scirpus ferrugineus L. Sp. Pl. 50. 1753.

Perennial, with short rhizomes; culms filiform to 2 mm. wide, 2–8 dm. high; leaves much shorter than culm, the blades often nearly obsolete; spikelets commonly 5–10, ovoid-oblong, 8–20 mm. long, the scales brown or ferruginous, pilose-

puberulent toward the apex; achene obovate, biconvex, dull yellow, opaque, the surface lightly reticulate.

Maritime shores from Cuba southward; tropics of Old World.

COLÓN: Colón, *Lehmann 998*. CANAL ZONE: France Field, *Standley 28581*.

5. FIMBRISTYLIS MILIACEA (L.) Vahl, Enum. 2:287. 1806.

Scirpus miliaceus L. Syst. Nat. ed. 10. 868. 1759.
Trichelostylis miliacea Nees in Wight, Contrib. Bot. India, 103. 1834.

Annual, slender, glabrous, 2–7 dm. high; leaves soft, 1–3 mm. wide, usually shorter than the culms; spikelets numerous, subglobose, 2–4 mm. long, brown, in a decompound inflorescence; achenes trigonous, minute (0.5 mm. long), pale brown, frequently iridescent.

In wet, often sandy soil, at low altitudes. Tropical regions of both hemispheres.

BOCAS DEL TORO: Changuinola Valley, *Dunlap 244*. CHIRIQUÍ: vic. David, *Hitchcock 8370*. CANAL ZONE: Victoria Fill near Miraflores Locks, *Allen 1719*; Gatún, *Bro. Heriberto 52*; *J. F. Cowell 317*; Darién, *Standley 31538, 31506*; Summit, *Standley 30143*; Río Pedro Miguel, *Standley 30023*; Frijoles, *Standley 27645*; Culebra, *Hitchcock 8116*; Fort Randolph, *Standley 28633, 28621*; and other collections. PANAMÁ: Las Sabanas, *Standley 25942*; Chepo, *Pittier 4614, 4530*; Almirante, *Rowlee & Stork 993*; Punta Paitilla, *Bro. Heriberto 232*; Matías Hernández, *Standley 31937, 28903*; Nuevo San Francisco, *Standley 30749*; Juan Díaz, *Killip 4049*; Panamá, *Standley 27793*; Río Tecúmen, *Standley 26523*. DARIÉN: El Real, ca. 15 m., *Allen 953, 963*.

6. FIMBRISTYLIS COMPLANATA (Retz.) Link, Hort. Berol. 1:292. 1827.

Scirpus complanatus Retz. Obs. Bot. 5:14. 1789.

Annual, or perennial with very short rhizomes, glabrous, 2–8 dm. high; leaves 2–6 mm. wide, shorter than the strongly compressed culms; spikelets numerous, linear, 5–10 mm. long, in a decompound inflorescence; achenes trigonous, pale brown, 0.7–0.9 mm. long, usually with horizontally elongate reticulation.

In dry fields or savannas. Widely distributed in the tropics of both hemispheres.

CHIRIQUÍ: Finca Lérida to Boquete, ca. 1300–1700 m., *Woodson, Allen & Seibert 1153*. COCLÉ: El Valle, 800–1000 m., *Allen 746*; Aguadulce, *Pittier 4924, 4869*; Penonomé, *Williams 307*. PANAMÁ: between Pacora and Chepo, ca. 25 m., *Woodson, Allen & Seibert 1635*; Corozal Road, *Killip 4096*; Orange River, *Killip 4178*.

7. SCIRPUS L.

SCIRPUS L. Sp. Pl. 47. 1753.

Annuals or perennials, the culms leafy below, or the leaves often reduced to sheaths; flowers perfect, the spikelets terete or slightly compressed; scales spirally imbricate; perianth of 1–6 bristles, or lacking; stamens 2–3; style 2- to 3-cleft, frequently deciduous; achene triangular or lenticular. About 200 species, widely distributed, chiefly in temperate regions.

1. SCIRPUS CUBENSIS Kunth, Enum. 2:172. 1837.

Plants stout, perennial, glabrous, with long stolons, the culms erect or decum-

bent, 30–70 cm. long; leaves basal, strongly reticulate, 5–9 mm. wide, usually equaling the culms; bracts long and leaf-like; inflorescence mostly on rays 1–5 cm. long, of dense globose heads, 1–1.5 cm. in diameter; spikelets 4–8 mm. long; scales ovate, acute, brown; style bifid; achene narrowly obovoid, smooth, pale; bristles none.

Usually growing in shallow water. Widely distributed in tropical America.

CANAL ZONE: Frijoles, *Killip 4305; Piper 5827;* Ancón, *Dunn* in 1916; Darién Station, *Standley 31530;* Barro Colorado Island, *Kenoyer 157;* Gigante Bay, *Dodge 3485.*

8. FUIRENA Rottb.

FUIRENA Rottb. Descr. & Icon. 70. 1773.

Plants perennial, with leafy triangular culms; spikelets many-flowered, terete, in terminal and axillary clusters, or solitary; scales spirally imbricate, awned, the lowest 1 or 2 usually empty; flowers perfect; perianth of 6 bristles (scales), frequently thickened and sometimes becoming ovate; stamens 3; style 3-cleft, deciduous; achenes 3-angulate, smooth, stipitate or sessile. About 30 species, in the warmer regions of both hemispheres.

a. Clusters of spikelets few, usually 4–5; leaves short, the blades less than 7 mm. wide, sparsely or densely pilose ..... 1. F. INCOMPLETA
aa. Clusters of spikelets numerous; leaves elongate, 8 mm. wide or more, glabrous or scabrous.
b. Inner bristles obovate, scarcely stipitate, scarcely thickened at the apex ..... 2. F. UMBELLATA
bb. Inner bristles ovate-lanceolate, conspicuously stipitate, much thickened at the apex ..... 3. F. ROBUSTA

1. FUIRENA INCOMPLETA Nees in Mart. Fl. Bras. 2^1:107. 1843.

Culms rather slender, about 60 cm. long; leaves stiff, the blades 5–12 cm. long; spikelets 8–12 mm. long, the scales pubescent, aristate, not closely appressed; bristles 4–6, slender, equaling or exceeding the achene, retrorsely barbed.

Wet meadows. Known also from Brazil.

CHIRIQUÍ: El Boquete, *Killip 4573; Hitchcock 8260.*

2. FUIRENA UMBELLATA Rottb. Descr. & Icon. 70. *pl. 19, f. 3.* 1773; C. B. Clarke, Ill. Cyp. *t. 59, f. 9.* 1909.

Plants with creeping rhizomes; culms 0.5–1.5 m. long, stout, sometimes pilose above, often bulbous at the base; leaves 7–16 cm. long, 8–25 mm. wide, usually scabrous; spikelets oblong, 6–10 mm. long, clustered, the scales pubescent, aristate, with spreading or recurved awns; bristles ovate, membranous, not stipitate.

An abundant species in damp places, in tropics of both hemispheres.

BOCAS DEL TORO: Maccaw Hills, Colón Island, alt. 0–120 m., *von Wedel 545;* Colón Island, Chiriquí Lagoon, *von Wedel 2796;* Changuinola Valley, *Dunlap 169.* COCLÉ: between Las Margaritas and El Valle, *Woodson, Allen & Seibert 1716.* CANAL ZONE: between Corozal and Ancón, *Pittier 2182;* Frijoles, *Killip 12184;* Darién Station, *Standley 31583;* between France Field and Cativa1, *Standley 30393;* Fort Randolph, *Standley 28619.* PANAMÁ: east of Pacora, 25 m., *Woodson, Allen & Seibert 756;* Chepo, *Pittier 4550.*

3. Fuirena robusta Kunth, Enum. 2:185. 1837; C. B. Clarke, Ill. Cyp. *t. 59, f. 12.* 1909.

Culms stout, glabrous or nearly so; leaves elongate, 1–2 cm. wide, scabrous; spikelets very numerous, grayish puberulent, 1–1.5 cm. long, the scales pubescent; bristles fleshy, nearly twice as long and as thick as the achene.

Brazil, Dutch Guiana; known from Panama only from the collection by Fendler.

CANAL ZONE: Chagres, *Fendler 353*, Jan. 10, 1850.

9. ASCOLEPIS Nees

Ascolepis Nees ex Steud. Syn. Cyp. 105. 1855.

Glabrous annuals closely resembling *Lipocarpha;* spikes composed of numerous closely imbricated 3-scaled reduced spikelets, of which the outermost scale is linear and obscure, and the two innermost fused to form a prominent obovate saccate scale containing the plano-convex to trigonous elongate achene; stamens 2 or 3; style 2- to 3-cleft. About 9 species, chiefly in tropical Africa.

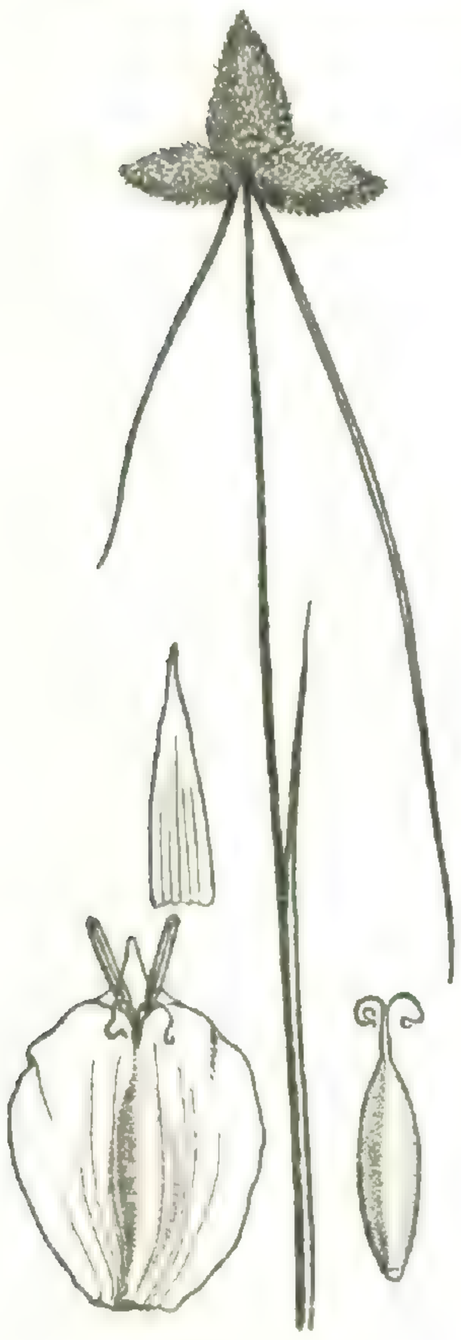


Fig. 33
Ascolepis brasiliensis

1. Ascolepis brasiliensis (Kunth) Benth. ex Clarke in Durand & Schinz, Consp. Fl. Afr. 5:651. 1895.

Platylepis brasiliensis Kunth, Enum. 2:269. 1837.

Plants perennial (?), tufted, glabrous, the culms 2–5 dm. high, slender; leaves basal, stiff, much shorter than the culms, with reddish sheaths and filiform blades; spikelets 1–3, sessile, terete, acute, subtended by 2 linear bracts, 6–12 mm. long; outer scale of spikelet obscure, narrowly lanceolate, the inner scales larger and fused to form a compressed rounded short-acuminate utricle enclosing the style and stamens; style bifid; achene oblong, 1 mm. long, obscurely trigonous, densely papillose.

Wet meadows. Brazil; tropical Africa and Madagascar.

CHIRIQUÍ: El Boquete, *Killip 4750.*

10. LIPOCARPHA R. Br.

Lipocarpha R. Br. App. Tuckey Exp. Congo, 459. 1818. Cf. Pfeiffer in Fedde, Rep. Spec. Nov. 39:38-43. 1935.

Glabrous annuals or perennials, with leaves usually much shorter than the culms; inflorescence terminal, of several terete, sessile spikes, with an involucre of 2 or 3 leafy to subulate bracts; the individual spikes composed of numerous closely imbricated 3-scaled reduced spikelets, of which only the outermost scale is promi-

nent, the 2 hyaline and obscure inner scales enveloping the plano-convex to trigonous elongate achene; stamens 1 or 2; style 2–3-cleft. About 14 species in the tropics of both hemispheres.

a. Rigid perennial; scales broadly obovate; achene obovate ..... 1. L. SELLOWIANA
aa. Annual with soft leaves; scales narrow; achene linear ..... 2. L. MACULATA

1. LIPOCARPHA SELLOWIANA Kunth, Enum. 2:267. 1837; Osten, Anal. Mus. Hist. Nat. Montevideo, II. 3:116, *f. 28*. 1932.

Perennial, with rigid sulcate culms 1.5–8 dm. long, 1.0–1.5 mm. wide; leaves basal, much shorter than the culm, 1.0 mm. wide or less, both sheaths and blades indurated, the blades serrulate at the apex; inflorescence terminal, of 3–5 sessile spikes, with 2 involucral bracts 1–7 mm. long; scales firm, subaristate, frequently incurved, yellow to dull brown, 1.0–1.5 mm. wide, broadly cuneate-obovate; inner scale hyaline, only slightly longer than the achene which it encloses; achene narrowly obovate, 1.0–1.2 mm. long, 0.5 mm. wide, yellow to dull brown, prominently papillose.

Mostly in bogs from 600 to 1500 m.; of scattered distribution from Mexico to Paraguay.

CHIRIQUÍ: El Boquete, alt. 1200–1500 m., *Woodson & Schery 747; Cornman 2697;* Llanos del Volcan, *Seibert 370*. COCLÉ: El Valle de Antón, *Allen 1993*.

2. LIPOCARPHA MACULATA (Michx.) Torr. Ann. N. Y. Lyc. 3:288. 1836.

Kyllinga maculata Michx. Fl. Bor.-Am. 1:29. 1805.
Lipocarpha sphacelata (Vahl) Kunth, Enum. 2:267. 1837; at least as to citations from Panama.

Cespitose annual, with slender sulcate culms 0.5–3.5 dm. long, 0.5–1 mm. wide; leaves basal, soft, 1–2 mm. wide, shorter than, or sometimes equalling the culm; inflorescence terminal, of 3–5 sessile spikes, with 2–3 involucral bracts 1–12 cm. long; spikes ovoid, obtuse, terete, 4–10 mm. long; scales hyaline to subrigid, acute, frequently incurved, yellow to purple, 0.7–0.8 mm. wide, lanceolate to broadly cuneate, inner scale hyaline, carinate, often nearly twice as long as the achene which it encloses; achene linear, 0.9–1.2 mm. long, 0.3–0.4 mm. wide, yellow to dark brown, lightly papillose.

Moist places, southern United States and southward in the tropics.

COCLÉ: Antón, *Woodson, Allen & Seibert 1710;* Aguadulce, *Pittier 4895*. CANAL ZONE: Darién Station, *Standley 31507;* Chagres, *Fendler 344, 346*. PANAMÁ: sea level, Las Sabanas, *Standley 40769;* Juan Díaz, *Killip 4050;* Chepo, *Pittier 4522;* Nuevo San Francisco, *Standley 30762;* Matías Hernández, *Standley 28996;* Panamá, *Standley 27812*.

11. REMIREA Aubl.

REMIREA Aubl. Hist. Pl. Guian. 1:45, *t. 16*. 1775. Cf. Pfeiffer, Rep. Spec. Nov. 29:180-185. 1931, and 39:187-192. 1936.

Stiff creeping perennial with cord-like rootstocks; the inflorescence terminal, of 3–4 sessile terete spikes, with an involucre of several leafy bracts; the individual spikes composed of loose nearly terete spikelets, each 4-scaled, the uppermost scale

of each spikelet corky and enclosing the single linear trigonous achene; stamens 3; style 3-cleft. A single species in maritime sands of the tropics in both hemispheres.

1. REMIREA MARITIMA Aubl. Pl. Guian. 1:45. *t. 16.* 1775.

Fig. 34
Remirea maritima

A glabrous perennial with long slender rhizomes; culms 5–30 cm. long, erect or nearly prostrate, densely leafy; leaves spreading, stiff, 2–8 cm. long; bracts 2–6, similar to the leaves; spikelets in a dense head, 1-flowered, brownish, 3–5 mm. long, the inner scale corky and inflated; stamens 3; style usually 3-cleft; achene 2 mm. long, elliptic, obscurely trigonous, apiculate, dark brown, lightly papillose.

A stiff plant of tropical shores of both hemispheres, with roots extending deeply into the sand. Said by Standley to have been collected by Fendler at Chagres.

12. CLADIUM P. Br.

CLADIUM P. Br. Civ. & Nat. Hist. Jam. 114. 1756.
Mariscus Zinn, Cat. Hort. Goett. 79. 1757.

Leafy perennials with habit of *Rynchospora*, the panicles elongate to diffuse; spikelets terete, with many scales; middle scales frequently subtending staminate flowers, only the uppermost flower fertile; achene terete, spongy, the surface smooth or ridged, not capped by a tubercle; stamens 2 or 3; style 2- to 3-cleft. About 40 species chiefly in the Old World Tropics.

1. CLADIUM JAMAICENSE Crantz, Inst. 1:362. 1766.
Schoenus Mariscus L. Sp. Pl. 42. 1753 (in part).
Cladium Mariscus R. Br. Prodr. Fl. Nov. Holl. 236. 1810.
Mariscus jamaicensis Britton in Britt. & Brown, Illustr. Fl. 1:348. 1913.

A coarse perennial 1.5–3 m. high, the culms obtusely triangular, leafy; leaves elongate, 6–20 mm. wide, the margins spinulose-serrulate; spikelets 2–5 in a cluster, in large panicles, acute-ovoid, 4–5 mm. long, the uppermost flower perfect; perianth none; stamens 2; achene ovoid, 2 mm. long, sharp-pointed, wrinkled, narrowed to the base.

A widely-distributed species, from Florida southward; known as saw-grass.

13. DICHROMENA Michx.

DICHROMENA Michx. Fl. Bor. Amer. 1:37. 1803.

Plants perennial; spikelets few, pointed, compressed, several- to many-flowered, in a dense terminal head, surrounded by an involucre of bracts, these often white

at the base; scales spirally imbricate, some of them empty or with imperfect flowers; perianth none; stamens 3; style 2-cleft; achene lenticular, transversely rugose, capped by the persistent style base (tubercle). About 20 species, in the Western Hemisphere.

a. Leaves 5–12 mm. wide; bracts green at the base ..... 1. D. WATSONI
aa. Leaves 2–4 mm. wide; bracts sometimes whitish.
  b. Scales of the spikelet pubescent; achenes with about 6 prominent transverse ridges ..... 2. D. PUBERA
  bb. Scales of the spikelet glabrous; achenes minutely undulate ..... 3. D. CILIATA

1. DICHROMENA WATSONI Britton, Bull. Torrey Club 15:101. 1888.

Perennial; culms stout, tufted, 1.5–6 dm. high, leafy; leaves 10-20 cm. long, glabrous; bracts about 9, resembling the leaves; spikelets about 9, brown, 12–15 mm. long, mostly hidden by the prominent involucre; achene transversely rugose, 1 mm. long, nearly orbicular, with a very broad flattened style-base.

Guatemala to Panama in forests at low elevations.

CANAL ZONE: Quebrada Salamanca, 70- m., *Steyermark & Allen 17145;* Frijoles, *Standley 27559.*

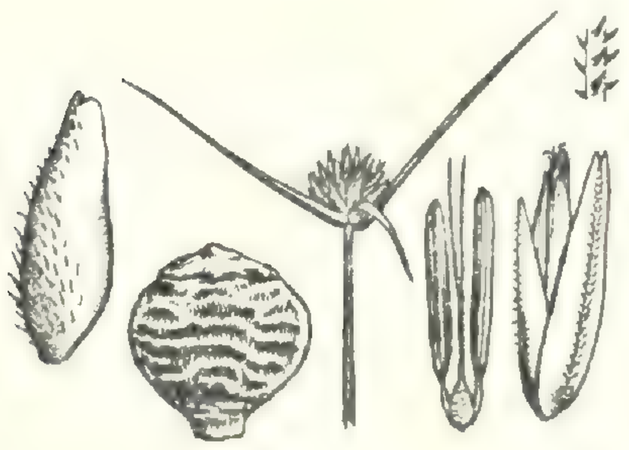


Fig. 35
Dichromena pubera

2. DICHROMENA PUBERA Vahl, Enum. 2:241. 1806; C.B.Clarke, Ill. Cyp. *t. 63, f. 2–4.* 1909.

Usually perennial; culms tufted, 1.5–4 dm. high; leaves numerous, usually shorter than the culms, 2–4 mm. wide, glabrous or pubescent; bracts ciliate at the base, elongate; spikelets elongate, 2–6, 5–8 mm. long; achenes suborbicular, deeply ridged transversely.

Tropical South America.

BOCAS DEL TORO: Water Valley, Chiriquí Lagoon, *von Wedel 1418.* SAN BLAS: Puerto Obaldía, *Pittier 4372.* CANAL ZONE: Barro Colorado Island, *Standley 40831;* Ancón Hill, *Cornman 2556.* PANAMÁ: Corozal Road, *Standley 26849;* Punta Paitilla, *Bro. Heriberto 233.*

Fig. 36
Dichromena ciliata

3. DICHROMENA CILIATA Vahl, Enum. 2:240. 1806; C.B.Clarke, Ill. Cyp. *t. 63, f. 5.* 1909.

Dichromena radicans of auths., probably not of Chamisso & Schlechtendal.

Culms 1–7 dm. high, slender; leaves 10–30 cm. long, glabrous or pilose; bracts 4–6, usually ciliate toward the base; spikelets 3–15, 5–10 cm. long, the scales glabrous and usually tinged with brown; achene 1–1.5 mm. long, obovate, brown or black, with numerous minute transverse undulations.

An abundant species, widely dispersed from the West Indies and Mexico to tropical South

America. The accompanying figures agree with Clarke's illustrations, and with the specimens in Vahl's herbarium examined by me in 1937.

CANAL ZONE: Ancón Hill, *Greenman & Greenman 5139;* Ancón, *Standley 26362;* Balboa, *Maxon 6928; Standley 25468, 32100;* Chivi-Chivi Trail, *Piper 5758;* Corozal, *Standley 29105;* Colón, *Rose 22060;* Mt. Hope Cemetery, *Standley 28778;* Culebra, *Bro. Celestine 64; Hitchcock 8119.* PANAMÁ: Arraiján, ca. 15 m., *Woodson, Allen & Seibert 1393;* east of Pacora, ca. 25 m., *Woodson, Allen & Seibert 744;* Savana de Alhajuela, *Pittier 3480;* Río Tapia, *Maxon & Harvey 6629; Standley 28157;* Río Tecúmen, *Standley 26615;* Matías Hernández, *Standley 28866;* Juan Díaz, *Standley 31984;* Chepo, *Pittier 4466;* Bella Vista, *Macbride 2746;* Taboga Island, *Pittier 3580;* Las Sabanas, *Standley 25915.* DARIÉN: El Real, ca. 15 m., *Allen 954.*

14. RYNCHOSPORA Vahl

RYNCHOSPORA Vahl, Enum. 2:229. 1806.

Plants mostly perennial, sometimes annual, the culms 3-angulate or terete; spikelets oblong or fusiform, variously arranged, the scales 1-nerved, spirally imbricate; upper flowers staminate, the lower perfect; perianth of bristles, or sometimes wanting; stamens usually 3; style 2-cleft or rarely entire; achene lenticular or turgid, smooth or transversely rugose, capped by the persistent style base. About 200 species, widely distributed, especially in warm regions.

a. Spikelets all crowded in a single dense head.
  b. Bracts 10–30 cm. long; leaves 8–15 mm. wide ..... 1. R. CEPHALOTES
 bb. Bracts 4 cm. long or less; leaves 3 mm. wide or narrower.
  c. Plants glabrous; bracts not ciliate ..... 2. R. GLOBOSA
  cc. Plants pubescent; bracts ciliate.
   d. Bracts partly leaf-like; outer spikelets reflexed or spreading ..... 3. R. BARBATA
   dd. Bracts all thin and scarious; spikelets all erect ..... 4. R. ARMERIOIDES
aa. Spikelets variously arranged but never in a single head.
  b. Branches of the style equaling or longer than the undivided portion.
   c. Spikelets 1–1.5 mm. long ..... 5. R. MICRANTHA
   cc. Spikelets 3–10 mm. long.
    d. Achenes reticulate ..... 6. R. HIRSUTA
    dd. Achenes transversely rugose.
     e. Spikelets in congested heads; dwarf annual plants; achene 1 mm. long, tridentate at the apex ..... 7. R. SETACEA
     ee. Spikelets in wide-spreading corymbs.
      f. Base of the style depressed, almost discoid; scales very acute ..... 8. R. EXIMIA
      ff. Base of the style pyramidal; scales obtuse ..... 9. R. ROBUSTA
  bb. Branches of the style short or none, much shorter than the undivided portion.
   c. Spikelets in globose heads ..... 10. R. CYPEROIDES
   cc. Spikelets not in globose heads.
    d. Spikelets fasciculate, in 2's–6's, yellow or yellow-brown.
     e. Inflorescence elongate, of several corymbs ..... 11. R. CORYMBOSA
     ee. Inflorescence a single corymb ..... 12. R. AMAZONICA
    dd. Spikelets mostly solitary, greenish or chestnut-brown.
     e. Inflorescence much shorter than the basal leaves; leaves silvery ..... 13. R. ARGENTEA
     ee. Inflorescence much surpassing the basal leaves; leaves green.
      f. Bristles obsolete or nearly so; spikelets stramineous; inflorescence-branches elongate ..... 14. R. POLYPHYLLA
      ff. Bristles equaling or longer than the achenes; spikelets greenish to dark brown; inflorescence-branches broadly triangular.

g. Spikelets 3–4 mm. long ..... 15. R. LOCUPLES
gg. Spikelets dark brown, 7–9 mm. long ..... 16. R. MACROCHAETA

1. RYNCHOSPORA CEPHALOTES (L.) Vahl, Enum. 2:237. 1806.

Scirpus cephalotes L. Sp. Pl. ed. 2. 76. 1762.

Rhizomes coarse; culms usually 1 m. high, leafy; leaves long, flat, 4–12 mm. wide, scabrous on the margin; spikelets greenish or pale brown, numerous in a dense ovoid head 2–4 cm. long; bracts large and leaf-like; spikelets about 7 mm. long; achene 1.5 mm. long, nearly orbicular, light brown, reticulate; bristles 6, equaling the achene, the beak longer than the body.

An abundant forest species, Mexico and the West Indies to northern South America. The plant is rarely collected in fruit.

VERAGUAS: between Cañazas and the foot of the Cordillera Central, headwaters of Río Cañazas, 300–600 m., *Allen 182.* CANAL ZONE: Río Indio, 70–100 m., *Dodge & Allen 17373, 17375;* Ancón Hill, *Greenman & Greenman 5103;* Barro Colorado Island, *Svenson 426.* PANAMÁ: Arraiján, ca. 15 m., *Woodson, Allen & Seibert 1382;* along Río Tecúmen, n. of Chepo road, up to 30 m., *Hunter & Allen 246;* Taboga Island, G. S. *Miller 2039;* Trapeche Island, Pearl Islands, *Miller 1897.*

2. RYNCHOSPORA GLOBOSA (HBK.) R. & S. Syst. 2:89. 1817.

Glabrous, culms 3–9 dm. high, in small dense tufts; leaves basal, 15–50 cm. long, 3–5 mm. wide, stiff and rigid, brown and indurate below; heads globose, 1–2 cm. in diameter; one of the bracts longer than the head, the others shorter; spikelets brownish, a single achene maturing in each; scales rigid, obtuse; achene biconvex, truncate, dark brown, the white narrow beak half as long as the achene; bristles 5, upwardly barbed, almost plumose.

Dry hillsides; Mexico and the West Indies to Bolivia.

COCLÉ: between Las Margaritas and El Valle, *Woodson, Allen & Seibert 1284.* PANAMÁ: Taboga Island, ca. 0–186 m., *Woodson, Allen & Seibert 1476.*

3. RYNCHOSPORA BARBATA (Vahl) Kunth, Enum. 2:290. 1837.

Schoenus barbatus Vahl, Eclog. Amer. 2:4. 1798.
Chaetospora pterocarpa HBK. Nov. Gen. & Sp. 1:230. 1816.
Rynchospora pterocarpa R. & S. Syst. 2:89. 1817; C. B. Clarke, Ill. Cyp. *t. 5, f. 4–6.* 1909

Fig. 37
Rynchospora barbata

Plants in small dense tufts, the culms slender, 1–5 dm. high; leaves basal, pilose, usually much shorter than the culms, 1–2 mm. wide; heads globose, about 1 cm. in diameter, brownish, subtended by about 4 short bracts; achene obovoid, black, 1–1.5 mm. long, with a broad membranous silvery wing 2 mm. broad with involute margins; bristles 4–5, equaling or exceeding the achene.

Dry to wet grasslands; Honduras, Panama, and the West Indies to southern Brazil.

COCLÉ: El Valle, 800–1000 m., *Allen 768;* Natá, alt. 50 m., *Allen 849.* PANAMÁ: between Panamá and Chepo, *Dodge, Hunter, Steyermark & Allen 16693;* Pacora, alt.

ca. 35 m., *Allen 993;* Chepo, 30 m., *Hunter & Allen 39;* between Pacora and Chepo, ca. 25 m., *Woodson, Allen & Seibert 1639.*

4. RYNCHOSPORA ARMERIOIDES Presl, Rel. Haenk. 1:197. *pl. 31, f. 2.* 1828.

Culms tufted, 0.5–3 dm. high; leaves basal, shorter than the culms, more or less ciliate, 2–3 mm. wide; heads frequently 1 cm. high, pale brown, the outer scales enlarged and ascending; achene linear, 2.5 mm. long, strongly compressed, pale brown, the surface minutely roughened, beak compressed, translucent white, elongate; bristles 5, three times as long as the achene-body, upwardly barbed.

Savannas; Costa Rica, Panama and South America. (TYPE from Panama.)

PANAMÁ: Bejuco, *Allen 983;* Pacora, alt. ca. 35 m., *Allen 992;* between Panamá and Chepo, *Dodge, Hunter, Steyermark & Allen 16688.*

5. RYNCHOSPORA MICRANTHA Vahl, Enum. 2:231. 1806.

Dichromena micrantha Kunth, Enum. 2:278. 1837.

Plants annual, slender, weak, 1–5 dm. high, the culms leafy; leaves shorter than the culms, 1–1.5 mm. wide; spikelets clustered, about 1.5 mm. long, in lax, slender corymbs; achene obovate, biconvex, 0.8 mm. long, white to dull gray, transversely rugose, with a broad depressed style-base; bristles lacking.

Wet grassy places at lower elevations, Central America and West Indies; tropical Africa.

CANAL ZONE: Ancón Hill, *Cornman 2559.* PANAMÁ: Chepo, 30 m., *Hunter & Allen 46, 48.*

6. RYNCHOSPORA HIRSUTA Vahl, Enum. 2:231. 1806.

Schoenus hirsutus Vahl, Eclog. Amer. 1:6. 1796.

Annual, 10–30 cm. high, hairy-setose, the culms slender, leafy; leaves equaling or shorter than the culms, 1–3 mm. wide, frequently inrolled; corymbs 2–4 cm. broad; spikelets numerous, 4 mm. long, brown or castaneous; achene minute, biconvex, coarsely reticulate, yellow-brown, suborbicular, the style-base depressed-conic; bristles lacking.

Panama (cited by Standley), Cuba and northern South America.

7. RYNCHOSPORA SETACEA (Berg) Boeckl. Vid. Medd. Kjobenhavn 1869:159. 1870.

Schoenus setaceus Berg. Act. Helv. 7:130. *pl. 9.* 1772.
Rynchospora tenerrima Spreng. Syst. Veg. Cur. Post. 26. 1827; C. B. Clarke, Ill. Cyp. *t. 71, f. 11–12.* 1909.

Glabrous annual with slender leafy culms 1–3 dm. high; leaves setaceous, 10–15 cm. long, 1–2 mm. wide; corymbs loose, the spikelets few, 4 mm. long, pale, long-awned, overtopped by the bracts and upper stem-leaves; achenes 1 mm. long, transversely undulate, brown, the apex tridentate due to the upturned margins of the style-base; bristles none.

Dry savannas; Panama, West Indies and tropical South America.

PANAMÁ: Las Cruces Trail, *Cornman 2614.*

8. RYNCHOSPORA EXIMIA (Nees) Boeckl. Linnaea 37:601. 1873.

Spermodon eximius Nees in Seem. Bot. Voy. Herald, 222. 1854.

Glabrous annual; culms slender, 1–4 dm. high; leaves often exceeding the culms, 1–3 mm. wide; corymbs spreading, the long-pedicelled spikelets relatively few, 7–10 mm. long, dark brown; achenes suborbicular, yellow-brown, 1.5 mm. long, transversely rugose, the two flattened lateral lobes of the style-base decurrent on the apex of the achene; bristles none.

Wet savannas, chiefly at low altitudes. Further distribution: Mexico, Honduras, Cuba.

COCLÉ: Natá, ca. 50 m., *Allen 819.* PANAMÁ: Pacora, alt. ca. 35 m., *Allen 991;* Orange River, *Cornman 2508.*

9. RYNCHOSPORA ROBUSTA (Kunth) Boeckl. Linnaea 37:616. 1873.
Dichromena robusta Kunth, Enum. 2:283. 1837.

Perennial, glabrous except the inflorescence branches; culms leafy, 6–10 dm. high; leaves shorter than the culms, about 6 mm. wide, prominently striate, glaucous; cymes much-branched, large and broad, the acute glaucous-brown spikelets numerous, 7 mm. long; achene obovate, biconvex, 2.5 mm. long, stipitate, pale brown, the surface spinescent-papillose and lightly transversely ridged, style-base nearly as long as the achene, obtuse, glaucescent, the two lateral lobes prominent; bristles none.

In swamps, southern Mexico to South America.

CHIRIQUÍ: El Boquete, alt. 1200–1500 m., *Woodson & Schery 730, 742.*

10. RYNCHOSPORA CYPEROIDES (Sw.) Mart. Denkschr. Akad. Wiss. Muenchen 6:149. 1816-17.
Schoenus cyperoides Sw. Prodr. 19. 1788.
Rynchospora polycephala Kunth, Enum. 2:291.1837.

Glabrous perennial; culms 2–8 dm. high, leafy; leaves frequently longer than the culms, 2–5 mm. wide; heads 1–15, in a loose corymb 8–10 mm. in diameter, brown, the bracts filiform; achene 1–1.5 mm. long, narrowly obovate, smooth or transversely lightly undulate, roughened, the upper margin spinescent, brown, the scabrous beak equaling or exceeding the achene; bristles 6, upwardly barbed, exceeding the achene.

Wet savannas, chiefly below 100 m. altitude. West Indies, Mexico to Uruguay; tropical Africa.

PANAMÁ: east of Pacora, ca. 25 m., *Woodson, Allen & Seibert 750;* between Pacora and Chepo, ca. 25 m., *Woodson, Allen & Seibert 1640;* northeast of Hacienda La Joya, 50–300 m., *Dodge, Hunter, Steyermark & Allen 16914.*

11. RYNCHOSPORA CORYMBOSA (L.) Britton, Trans. N. Y. Acad. Sci. 11:85. 1892.
Scirpus corymbosus L. Cent. 2:7. 1756.
Rynchospora polysephala Kunth, Enum. 2:291. 1837.

Perennial, with culms scabrous above, stout, 6–10 dm. high; leaves long, 1–2 cm. wide; the several dense corymbs forming an interrupted inflorescence 2–4 dm. long; spikelets very numerous, 6–7 mm. long, containing a single achene; achene 2–3 mm. long, narrowly obovate, faintly reticulate, dark brown, the corky-

thickened beak equaling the achene; bristles 6, exceeding the achene, upwardly barbed.

Tropics of both hemispheres.

BOCAS DEL TORO: Old Bank Island, Chiriquí Lagoon, *von Wedel 2129.*

12. RYNCHOSPORA AMAZONICA Poepp. & Kunth ex Kunth, Enum. 2:292. 1837.

Culms triangular, leafy, slender, 5–10 dm. high; leaves 4–9 mm. wide, elongate, thickened, the margins tending to be revolute; inflorescence a corymb, the primary rays 5–9 cm. long, almost filiform; spikelets in clusters of 2–6 at the ends of primary rays and of filiform secondary rays (2–4 cm. long); spikelets dull brown, ovate-oblong, 5–7 mm. long; achene ellipsoid-obovate, 3 mm. long, compressed, dark brown, impressed-punctulate to rugose, the subulate pale yellow beak dilated at the base and exceeding the achene; bristles upwardly scabrous, exceeding the achene.

Boggy grasslands; tropical South America.

PANAMÁ: between Pacora and Chepo, ca. 25 m., *Woodson, Allen & Seibert 1663.*

13. RYNCHOSPORA ARGENTEA Standl. Contrib. U. S. Nat. Herb. 18:87. 1916.

Perennial; culms slender and weak, 20 cm. high or less; leaves silvery, 30–40 cm. long, 2–3 cm. wide, glabrous, scabrous on the margins; inflorescence much shorter than the leaves; corymbs small, the spikelets few, pale, 7 mm. long, solitary, pedicellate; bristles 6, white; fruit unknown.

SAN BLAS: *Pittier 4307,* known only from this collection.

14. RYNCHOSPORA POLYPHYLLA Vahl, Enum. 2:230. 1806.
Schoenus polyphyllus Vahl, Eclog. Amer. 2:5. 1798.

Perennial, with slender rhizomes, the leaves and inflorescence usually short-pubescent; culms often 1 m. long, weak and often reclining; leaves equaling the culms, 4–7 mm. wide; panicles elongate, often 2–3 dm. long, narrow, the pale spikelets very numerous; achene obovate, 1.5 mm. long, pale brown, reticulate, the flattened glaucescent beak exceeding the achene; bristles none.

In moist forests, Mexico and the West Indies to northern South America.

CHIRIQUÍ: El Boquete, *Davidson 751; Killip 4538.*

15. RYNCHOSPORA LOCUPLES Clarke, Engler's Bot. Jahrb. 34, Beibl. 78:5. 1904.

Perennial; the stout leafy glabrous culms nearly 1 m. high; leaves 10–18 mm. wide; panicles very large, the spikelets extremely numerous, pale brown, 3 mm. long, each maturing a single achene; achene 1.5 mm. long, pale brown, reticulate, the horizontally elongate cells with raised margins, the lanceolate beak equaling the achene; bristles none.

In moist forests, Costa Rica, Panama, Colombia.

CHIRIQUÍ: Río Caldera, 1650 m., *Killip 4537;* Bajo Chorro, 1900 m., *Woodson & Schery 653.*

16. RYNCHOSPORA MACROCHAETA Steud. in Lechler, Berberides Amer. Centr. 56. 1857.

Rynchospora Hoffmanni Boeckl. Linnaea 37:637. 1873.

Perennial, glabrous or nearly so, about 1 m. high, with short rootstocks, the culms stout, leafy; panicles of few corymbs, the spikelets numerous, 6–8 mm. long; achene obovate, 3 mm. long, smooth, pale grayish-brown, the lanceolate grayish beak longer than the achene; bristles none.

Costa Rica, Panama, South America.

CHIRIQUÍ: Casita Alta to Cerro Copete, alt. 2300–3300 m., *Woodson & Schery 352.*

15. SCLERIA Berg.

SCLERIA Bergius, Vet. Akad. Handl. 26:142. 1765.

Mostly leafy perennials, with small monoecious spikelets in terminal or axillary fascicles, or in interrupted spikes; fertile spikelets 1-flowered with several empty scales; staminate spikelets many-flowered; achene crustaceous, globose to ovoid, frequently supported on a lobed or laciniate disc (hypogynium); stamens 1–3; style 3-cleft. About 100 species, chiefly in tropics of both hemispheres.

KEY I, BASED ON HABIT

a. Inflorescence verticillate in an interrupted spike; slender plants with leaves 1–4 mm. wide.
  b. Inflorescence unbranched; plants rough-hairy.
    c. Achenes smooth ..... 2. S. HIRTELLA
    cc. Achenes reticulate ..... 1. S. INTERRUPTA
  bb. Inflorescence often branched or lowest verticels long-peduncled.
    c. Verticels exceeded by elongate capillary bracts ..... 4. S. LITHOSPERMA
    cc. Verticels as long as bracts.
      d. Sheaths glabrous ..... 3. S. PURDIEI
      dd. Sheaths pubescent at apex ..... 5. S. MICROCOCCA
aa. Inflorescence a coarse extensively-branched panicle.
  b. Slender annual (?) with soft culms and roots; leaves usually 2–4 mm. wide ..... 12. S. SETACEA
  bb. Coarse perennial, with usually broader scabrous leaves.
    c. Leaves 3–5 cm. wide; culms soft and smooth ..... 10. S. LATIFOLIA
    cc. Leaves 0.2–3 cm. wide (sometimes broader in S. *macrophylla*, which has harsh sharply angled culms).
      d. Climbing scabrous plants with leaves 2–7 mm. wide ..... 15. S. SECANS
      dd. Non-climbing erect plants.
        e. Inflorescence bracts long subulate ..... 11. S. BRACTEATA
        ee. Inflorescence bracts leafy or inconspicuous.
          f. Culms retrorsely scabrous on margins ..... 14. S. SETULOSO-CILIATA
          ff. Culms smooth to slightly roughened on the margins.
            g. Sheath-ligule pubescent at apex.
              h. Rachis and bracts of inflorescence purplish-brown ..... 13. S. PTEROTA
              hh. Rachis and bracts dull brown to green.
                i. Inflorescence compact; pistillate scales glossy brown 9. S. EGGERSIANA
                ii. Inflorescence loose; pistillate scales dull yellow ..... 6. S. MICROCARPA
            gg. Sheath-ligule glabrous.
              h. Ligule lanceolate; green ..... 8. S. MITIS
              hh. Ligule short-ovate; purple-margined ..... 7. S. MACROPHYLLA

KEY II, BASED ON ACHENES

1. Hypogynium obscure or none. Sect. HYPOPORUM
   a. Achene reticulate, 1–1.5 mm. long.
      b. Reticulation shallow ..... 5. S. MICROCOCCA
      bb. Reticulation deep, the projections almost spinose ..... 1. S. INTERRUPTA
   aa. Achene smooth.
      b. Achene depressed-globose, 1 mm. long ..... 3. S. PURDIEI
      bb. Achene obovoid.
         c. Achene 1–2 mm. long ..... 2. S. HIRTELLA
         cc. Achene 3 mm. long ..... 4. S. LITHOSPERMA

2. Hypogynium ciliate on the margin. Sect. OPHYROSCLERIA
   a. Cilia 0.5–1.0 mm. long, half as high as the hypogynium.
      b. Achene 4 mm. long; the dense cilia purplish-brown ..... 8. S. MITIS
      bb. Achene 2.5–3 mm. long; the cilia pale brown, often in a single row ..... 9. S. EGGERSIANA
   aa. Cilia short and inconspicuous (ca. 0.1 mm. long).
      b. Achene very large, 3.5–6 mm. long ..... 7. S. MACROPHYLLA
      bb. Achene 2 mm. long ..... 6. S. MICROCARPA

3. Hypogynium with deeply fimbriate lobes. Sect. SCHIZOLEPIS
   a. Achene 2–3 mm. long, usually purplish ..... 10. S. LATIFOLIA

4. Hypogynium 3-lobed, the lobes entire. Sect. EUSCLERIA
   a. Achene reticulate.
      b. Achene-surface with small isodiametric cells; the hypogynium acutely 3-lobed ..... 12. S. SETACEA
      bb. Achene-surface horizontally ridged; the truncate hypogynium purple-margined ..... 11. S. BRACTEATA
   aa. Achene smooth.
      b. Achene white, obovate to ovoid.
         c. Hypogynium lobes reflexed ..... 15. S. SECANS
         cc. Hypogynium lobes crenulate and appressed ..... 14. S. SETULOSO-CILIATA
      bb. Achenes purple to white, depressed-globose; hypogynous lobes appressed ..... 13 S. PTEROTA

1. SCLERIA INTERRUPTA L. C. Rich, Act. Soc. Hist. Nat. Paris 1:113. 1792.
Scleria distans var. *interrupta* Kuekenth. Rep. Sp. Nov. 23:214. 1926.

Annual, with fibrous roots; culms 15–50 cm. high, triangular, sparsely hirsute with long white hairs or rarely glabrate; leaves 5–20 cm. long, 1–2 mm. wide, pubescent, flat, linear; sheaths pubescent; inflorescence glomerate-spicate, 5–10 cm. long; spikelets 2–4 mm. long; staminate scales lanceolate; pistillate scales ovate, purplish-tinged; hypogynium none; achene sparsely rugose-verrucose or tuberculate, 1–1.5 mm. long, mucronate, trigonous, 12-porose at the attenuate base.

Savannas and lava fields, West Indies to Central America and northern South America.

CANAL ZONE: Ancón Hill, *Killip 4120*. PANAMÁ: Panamá, *Killip 4058* (det. Core); Alhajuela, *Killip 4169*.

2. SCLERIA HIRTELLA Sw. Prodr. 19. 1788.

Pubescent perennial with slender rhizomes, the culms slender, 2–6 dm. long; leaves 2–4 mm. wide; spikes 5–20 cm. long, the spikelets hispidulous, in remote clusters; hypogynium none; achene 1–2 mm. long, obovoid to subglobose, white, smooth, shining, mucronulate, obscurely trigonous, the base cuneate-attenuate, not porose, or lightly 9- to 12-excavated.

Wet grassy lands, pine barrens and savannas, southern United States to northern Argentina and Chile; also in Africa.

CHIRIQUÍ: El Boquete, *Hitchcock 8325.* PANAMÁ: Las Sabanas, *Killip 4055a.*

3. SCLERIA PURDIEI C. B. Clarke, Kew Bull. Add. Ser. 8:57. 1908.
Scleria Hitchcockii Standl. Contrib. U. S. Nat. Herb. 18:88. 1916.

Plants slender, 5–7 dm. high; leaves 12–18 cm. long, 2–4 mm. wide, nearly glabrous; panicles about 10 cm. long, the branches very slender; spikelets sessile, in small dense clusters; hypogynium none; achene smooth, shining, depressed-globose, 1 mm. long, white, shorter than the scales.

Savannas and woodlands, Panama to Colombia and Venezuela.

CHIRIQUÍ: El Boquete, *Hitchcock 8326.*

4. SCLERIA LITHOSPERMA (L.) Sw. Prodr. 18. 1788.
Scirpus lithospermus L. Sp. Pl. 51. 1753.

Plants glabrous or nearly so, with stout rootstocks, the culms 3–9 dm. long; leaves 10–30 cm. long, 1–3 mm. wide; inflorescence sparsely branched, the spikelets in distant sessile clusters; hypogynium none; achene 3 mm. long, white, smooth, shining, oblong or ovate-elliptic, subacuminate, the attenuate trigonous base non-porose.

Dry thickets and open woods, especially on limestone, in nearly all tropical maritime regions.

CANAL ZONE: Ancón Hill, *Hitchcock 8324.*

5. SCLERIA MICROCOCCA (Liebm.) Steud. Syn. Cyp. 179. 1855.
Hypoporum micrococcum Liebm. Dansk. Vid. Selsk. Skr. V. 2:255. 1851.
Scleria Liebmanni Steud. op. cit. 179.
Scleria costaricensis Boeckl. Allg. Bot. Zeitschr. 2:157. 1896.

Plants annual, pubescent below, very slender, the culms 20–30 cm. long; leaves 2 mm. wide; inflorescence about 10 cm. long, the spikelets in small sessile clusters, the bracts shorter than the spikelets; hypogynium none; achene 1 mm. long, fenestrate-verrucose, white, shining apiculate, globose, shorter than the scales, the base trigonous, attenuate, 5-porose on each face.

Wet fields, Mexico to northern Brazil; also in Cuba.

CANAL ZONE: Ancón Hill, *Standley 25214.* PANAMÁ: Las Sabanas, *Killip 4055.*

6. SCLERIA MICROCARPA Nees, Linnaea 9:302. 1834.

Plants stout, with horizontal rhizomes, about 1 m. high; leaves 20–30 cm. long, 8–11 mm. wide, the sheaths narrowly 3-winged; panicles narrow, 20–50 cm. long; hypogynium-margin more or less densely white-ciliate or ciliolate; achene 1–2 mm. long, exceeding the scales, ellipsoid-ovoid, smooth, white, shining, tipped by the more or less persistent style-base.

Swamps, roadsides, and moist thickets, Cuba and Guatemala to Paraguay.

COLÓN: Río Sirrí, *Pittier 4022.*

7. SCLERIA MACROPHYLLA Presl, Rel. Haenk. 1:200. 1828.
Ophryoscleria asperrima Liebm. Dansk. Vid. Selsk. Skr. V. 2:261. 1851.

Perennial by stout rhizomes; culms coarse, smooth, or the angles sometimes scabrous, sharply triangular, 1–3 m. high; leaves linear-lanceolate, 5- to 7-nerved, rigid, attenuate-acuminate, 2–4 dm. long, 1–4.5 cm. wide, smooth or somewhat roughened on the margins and veins beneath; inflorescence paniculate, terminal and axillary; hypogynium large, undulately 3-lobed, the margin more or less ciliate; achene subglobose-ellipsoid, white or discolored, smooth, shining, 3.5–6 mm. long, tipped with the somewhat persistent conic pale style-base.

Marshes and swampy forests, Mexico to Brazil and Bolivia.

CANAL ZONE: Summit, *Standley 30060;* Darién Station, *Standley 31643* (immature and questionable). PANAMÁ: Juan Díaz, *Standley 30475;* Isthmus of Panama, *Fendler 360;* between Panamá and Chepo, *Dodge, Hunter, Steyermark & Allen 16670.*

8. SCLERIA MITIS Berg. Vet. Akad. Handl. Stockh. 26:145. 1765.

Plants stout and coarse, 1–2 m. high, nearly glabrous; leaves 30–50 cm. long, the sheaths 3-winged; panicles narrow, 50 cm. long or less, much branched; hypogynium truncate, densely fringed with brown or red-brown hairs; achenes ellipsoid, 4 mm. long, smooth, white, sometimes black or discolored, lustrous, tipped with the small conic black persistent style-base.

Clearings and wet banks, Guatemala and Cuba to Paraguay and Bolivia.

BOCAS DEL TORO: Old Bank Island, Chiriquí Lagoon, *von Wedel 1972.* CANAL ZONE: Victoria Fill, near Miraflores Locks, *Allen 1731;* Las Cruces, *Pittier 2616a;* Empire to Mandinga, *Piper 5497;* Gatún, *Hayes,* in 1860; Fort Randolph, *Maxon & Harvey 6515;* Chagres, *Fendler 359.* PANAMÁ: Pacora, *Killip 4322.*

9. SCLERIA EGGERSIANA Boeckl. Cyp. Nov. 2:41. 1890.
Scleria Grisebachii C. B. Clarke, Symb. Ant. 2:150. 1900.

Rhizome horizontal, thick, woody; culms coarse, 1–2 m. tall, triangular, erect, nearly smooth; leaves 30 cm. long or longer, 1–2.5 cm. wide, scabrous, especially on the veins and margins, coriaceous, rigid, flat or somewhat plicate; sheaths 3-winged, scabrous on the angles, otherwise glabrous; inflorescence paniculate, narrow, about 3 dm. long; hypogynium-margin densely brown-ciliate, cup-shaped, 3-lobed; achene 2.5–3 mm. long (with high hypogynium 4 mm. long), white, globose or subglobose, shining, smooth, terminated by the conic, pale, more or less deciduous style-base.

Fig. 38
Scleria latifolia

West Indies, Central America, and northern South America.

CANAL ZONE: Fort Randolph, *Standley 28730;* Barro Colorado Island, *Kenoyer 144;* between France Field and Cativa1, *Standley 30281.*

10. SCLERIA LATIFOLIA Sw. Prodr. 18. 1788.
Scleria arundinacea Kunth, Enum. 2:347. 1837.

Plants stout, 1 m. high or more; leaves 40–60 cm. long, 3–5 cm. wide, the sheaths broadly 3-

winged; panicles 40 cm. long or less; hypogynium 3-lobed, the lobes deeply fimbriate, the fimbriations brown or purplish; achene depressed-globose, white or purplish, smooth, 2–3 mm. long.

Moist shady places, Central America and the Lesser Antilles to Bolivia.

COCLÉ: El Valle, *Allen 209.* PANAMÁ: Campana, alt. 600–800 m., *Allen 1316.* DARIÉN: Cana-Cuasi Trail, Chepigana, 4500 ft., *Terry & Terry 1509.*

11. SCLERIA BRACTEATA Cav. Icon. 5:34. *pl. 451.* 1799.

Plants coarse, about 1 m. high, with stout rhizomes, copiously pubescent; leaves about 1 cm. wide, with very scabrous margins, the sheaths scarcely winged; panicles axillary and terminal, the upper ones staminate, usually brownish, conspicuously bracteate; hypogynium 3-lobed, the lobes rotund, with a dark purple margin, entire or sometimes dentate; achene discolored or usually white, 2–3 mm. long, subglobose, apiculate-verrucose or subtuberculate, pubescent, at least on the tubercles.

Moist thickets and borders of forests, Mexico and West Indies to Paraguay and Bolivia.

CANAL ZONE: Balboa, *Standley 25523;* Ancón Hill, *Piper 5544; Standley 26331; Killip 4069;* Summit, *Standley 26957;* Corozal, *Standley 29047.* PANAMÁ: Río Tapia, *Standley 28173;* Taboga Island, *Standley 28012; G. S. Miller 2020; Pittier 3615; Macbride 2829; Allen 113.*

12. SCLERIA SETACEA Poir. in Lam. Encycl. 7:4. 1806.

Scleria coriacea Liebm. Dansk. Vid. Selsk. V. 2:259. 1851.

Plants with fibrous roots, glabrous or nearly so, 30–60 cm. high, slender; leaves 1–4 mm. wide, the sheaths very narrowly winged; panicles small, axillary, with elongate bracts; hypogynium deeply 3-lobed, the lobes ovate-lanceolate, subacute, appressed; achene 2 mm. long, more or less reticulate, the transverse ridges pilose, sordid white, globose-elliptic, the ridges somewhat spirally arranged.

Pine barrens and low meadows, New York and Indiana to Florida and Texas; also in the West Indies, Central America and northern South America.

PANAMÁ: Matías Hernández, *Standley 32023, 28857;* Río Tecúmen, *Standley 26709.*

13. SCLERIA PTEROTA Presl in Oken, Isis 21:268. 1828.

Scleria pratensis Nees in Mart. Fl. Bras. 2^1:179. 1842.
Scleria melaleuca Schlecht. & Cham. Linnaea 6:29. 1831.
Scleria Pittieri Boeckl. Allg. Bot. Zeitschr. 2:159. 1896.

Plants with short rhizomes, 30–80 cm. high, rather stout, nearly glabrous; leaves 30 cm. long and 1 cm. wide or narrower; panicles axillary, small, sparsely branched, green or brownish, the bracts inconspicuous; hypogynium depressed, 3-lobed, the lobes broad, rounded, ciliate or glabrous; achene 1.5–2.5 mm. long, smooth, white to purplish, depressed-globose or sometimes pointed, apex subumbonate.

In boggy meadows and wet clearings throughout the West Indies and continental tropical America; common.

CANAL ZONE: Miraflores Lake, *G. White 184;* Ancón Hill, *Woodson, Allen & Seibert 1326;* between Peluca Hydrographic Station and Quebrada Peluca, along Río Boqueron,

70– m., *Steyermark & Allen 17246;* Balboa, *Standley 25299;* Gamboa, *Standley 28432;* Corozal, *Standley 29180, 27340.* PANAMÁ: east of Pacora, ca. 25 m., *Woodson, Allen & Seibert 747;* Taboga Island, *Woodson, Allen & Seibert 1541; Standley 28029; Pittier 3588;* Old Panamá, *Killip 4061;* Juan Díaz, *Killip 4047;* Matías Hernández, *Killip 6795.* DARIÉN: Marraganti, *Williams 1035.*

SCLERIA PTEROTA var. MELALEUCA Uittien, Fl. Surinam. 1:140. 1934.

Variant with blackish achenes.

BOCAS DEL TORO: Almirante, *Cooper 125;* Changuinola Valley, *Dunlap 204;* Laguna de Chiriquí, *Hart 85.* CHIRIQUÍ: David, *Hitchcock 8371.* CANAL ZONE: Tabernilla, *Hitchcock 8113;* Cerro Gordo, near Culebra, *Pittier 3734;* Río Grande, near Culebra, *Pittier 2122;* Darién Station, *Standley 31651;* Frijoles, *Piper 5809; Killip 4287;* Barro Colorado Island, *Standley 40833;* Summit, *Standley 29609;* Fort Randolph, *Standley 28706.* PANAMÁ: Chepo, *Pittier 4718;* Río Tecúmen, *Standley 26700, 26570;* Bella Vista, *Standley 25311;* Isthmus of Panama, *Fendler 358;* Las Sabanas, *Bro. Paul 88;* Arraiján, ca. 15 m., *Woodson, Allen & Seibert 1341.* DARIÉN: near mouth of Río Yapé, ca. 20 m., *Allen 361.*

14. SCLERIA SETULOSO-CILIATA Boeckl. Flora 65:30. 1882.

Plants stout, 0.5–1 m. high, tufted; leaves about 1 cm. wide, scabrous on the margins, the sheaths narrowly winged; panicles small, dense, with elongate bracts; hypogynium 3-lobed, the lobes appressed, rotund, the margins crenulate, white, the base dark-lined; achene 3–4 mm. long, ovoid, white, smooth, shining, mucronate.

Moist places and cultivated fields, Cuba and Mexico to Brazil.

CANAL ZONE: Summit, *Standley 26936.* DARIÉN: El Real, *Allen 962.*

15. SCLERIA SECANS (L.) Urban, Symb. Antill. 2:169. 1900.

Schoenus secans L. Syst. Nat. ed. 10. 865. 1759.
Scleria reflexa HBK. Nov. Gen. & Sp. 1:232. 1816.

Fig. 39
Scleria secans

Plants perennial, the culms long and weak, often reclining on shrubs or scandent to a height of 3 m. or more; leaves 2–7 mm. wide, stiff, very scabrous on the margins; panicles small, terminal and axillary, conspicuously bracteate, purplish or castaneous; hypogynium flat, subentire, the margin reflexed, undulate; achene 2–4 mm. long, globose-ovoid, white, smooth, shining, usually minutely white-pubescent, as long as the scales or nearly so.

Wet thickets and savannas, West Indies and Mexico to Bolivia.

CHIRIQUÍ: Río Dupí, near sea level, *Pittier 5245.* PANAMÁ: Taboga Island, *Pittier 3616;* Trapiche Island, Pearl Islands, 0–15 m., *Allen 2626.*

16. CALYPTROCARYA Nees

CALYPTROCARYA Nees in Linnaea 9:304. 1834.

Leaves long, linear; spikelets in small globular heads; achene biconvex, apicu-

late, style 2-fid; pistillate flowers with 2 distichous glumes and 2–4 staminate flowers at base. About 5 species, of tropical America.

1. CALYPTROCARYA GLOMERULATA (Brongn.) Urban, Symb. Antill. 2:169. 1900.

Becquerelia Glomerulata Brongn. in Duperrey, Voy. Coquille 2:163. 1829.
Calyptrocarya fragifera Kunth, Enum. 2:364. 1837.
Calyptrocarya Palmetto Nees in Mart. Fl. Bras. 2^1:195. 1842.

Fig. 40
Calyptrocarya glomerulata

Leafy perennial, with short thick rootstocks; culms 1.5–6 dm. high; leaves glabrous except for the scabrous margins, linear, 2–9 mm. wide, 3-nerved, usually longer than the culms; spikelets in glomerules on rays of compound or simple axillary corymbs; pistillate spikelet terminal, 1-flowered, without bristles, the staminate spikelets lateral, 1- to 4-flowered; stamen 1; style bifid; achene brownish, globose, puberulent, about 1 mm. long.

Occasional in forests or swamps, Central America to Brazil.

BOCAS DEL TORO: Old Bank Island, Chiriquí Lagoon, *von Wedel 2030*. COLÓN: Fató, *Pittier 3850*. CANAL ZONE: headwaters of Río Chinilla, *Maxon 6893;* Chagres, *Fendler 357;* Colón, *O. Kuntze 1848*. PANAMÁ: Juan Díaz, *Killip 4072*.

Fig. 41
Hypolytrum Schraderianum

17. HYPOLYTRUM L. C. Rich

HYPOLYTRUM L. C. Rich in Pers. Syn. 1:70. 1805.

Inflorescence a head, spike, or corymb; flowers with 2 or more stamens; scales 2 or more, 2 of them often connate; style 2-fid. A genus of about 50 species in the tropics of both hemispheres, closely resembling *Mapania*.

1. HYPOLYTRUM SCHRADERIANUM Nees in Mart. Fl. Bras. 2^1:65. *t.* 5. 1842; Svenson, Proc. Calif. Acad. Sci. IV. 22:191. 1939.

Hypolytrum nicaraguense Liebm. Dansk. Vid. Selsk. Skr. 2:235. 1851.

Leafy perennial, about 1 m. high, with stout triangular culms; leaves linear, 2–3 cm. wide, with scabrous margins; inflorescence corymbose-paniculate, many-flowered, sometimes nearly 2 dm. long; spikelets glomerulate on peduncles about 5 mm. long; inner scales (perianth) 2, with scabrous keels, stamens 2; style bifid; achene ovoid, 2.5 mm. long, corky, with variable raised nervation on the surface.

In forests, Central America to Brazil.

CANAL ZONE: Fort Randolph, *Maxon & Harvey 6538; Standley 28668;* Chagres, *Fendler 356.*

18. MAPANIA Aubl.

MAPANIA Aubl. Pl. Guian. 1:47. *t. 17.* 1775.

Large coarse glabrous perennials; spikelets in a single terminal head with a 3-leaved involucre; spikelets of 6 scales, the 2 lower sterile, the 3 above these staminate, the uppermost pistillate; style 2- to 3-cleft. About 45 species, in the tropics of both hemispheres.

1. MAPANIA SYLVATICA Aubl. Pl. Guian. 1:47. *t. 17.* 1775.

Culms 15–60 dm. high, leafless except for the involucral bracts; bracts 3, 8–14 cm. long and 2–6 cm. wide; spikes 1–2 cm. long, in a sessile head, ferruginous; style trifid; achene subglobose.

Fig. 42. *Mapania sylvatica*

In forests, Costa Rica to French and British Guiana, and Venezuela. Also cited by Standley.

DARIÉN: Cana-Cuasi Trail, near divide, Chepigana, rain forest at 5000 ft., *Terry & Terry 1515.*

19. UNCINIA Pers.

UNCINIA Pers. Syn. 2:534. 1807.

Perennials, the culms erect, leafy below; flowers unisexual, spicate; bracts 2,

connate and forming a bicarinate utricle, this enclosing the ovary; a rudiment of a spikelet present in the utricle, setiform, the apex exserted and uncinate. About 25 species, chiefly in the South Temperate Zone.

1. UNCINIA HAMATA (Sw.) Urban, Symb. Antill. 2:169. 1900.

Carex hamata Sw. Prodr. 18. 1788.
Uncinia jamaicensis Pers. Syn. 2:534. 1807.
Uncinia mexicana Steud. Syn. Cyp. 243. 1855.

Forming dense clumps 30–60 cm. high; leaves 2–7 mm. wide; culms bearing a single spike, 8–15 cm. long; utricles lanceolate; style 3-cleft; bristle more than twice as long as the utricle.

Southern Mexico and West Indies to southern Brazil and northern Argentina.

CHIRIQUÍ: Río Chiriquí Viejo valley, near El Volcán, *P. White 226;* Potrero Muleto to summit, Volcán de Chiriquí, alt. 3500–4000 m., *Woodson & Schery 458; Hitchcock 8203;* Cerro de la Horqueta, *Pittier 3199;* El Boquete, *Maxon 5589.*

20. CAREX L.

CAREX L. Sp. Pl. 972. 1753; Kuekenthal Pflanzenr. IV[20]:67-767. 1909; Mackenzie, N. Am. Fl. 18[9]:1-478. 1931-35, and N. Am. Caricaceae, *539 pl.* 1940.

A genus of more than 1000 species, chiefly in temperate and arctic regions.

a. Perigynia biconvex; stigmas 2 ..... 1. C. LEMANNIANA
aa. Perigynia trigonous; stigmas 3.
  b. Perigynia green or yellowish; straight.
    c. Perigynia 2.5–4 mm. long; achenes 1.5–2 mm. long ..... 2. C. POLYSTACHYA
    cc. Perigynia 4.5–5 mm. long; achenes 3 mm. long ..... 3. C. HUMBOLDTIANA
  bb. Perigynia purplish, strongly curved ..... 4. C. DONNELL-SMITHII

All the specimens seen by me from Panama have a paniculate inflorescence, though in *C. polystachya* the panicle may be greatly reduced.

1. CAREX LEMANNIANA Boott, Trans. Linn. Soc. 20:121. 1846; Mackenzie, op. cit. *t. 396.* 1940.

Carex Lemanniana var. *simplex* Kuekenth. op. cit. p. 405.

Culms 25–60 cm. high, brownish at the base; leaves numerous, clustered near the base, the leaf blades 2.5–8 mm. wide, glaucous, coriaceous, stiff, long-attenuate; inflorescence not or but sparingly compound, the spikes usually 4–10, androgynous, linear-cylindric, 2–6 cm. long, 3.5–5 mm. wide, the pistillate part 20- to 40-flowered; scales lance-ovate, usually rough-awned, purplish-black; perigynia oblong-ovate, 2.5 mm. long, 1 mm. wide, membranaceous, plano-convex, straw-colored and strongly purplish-splashed, obscurely striate ventrally, finely several-nerved dorsally, serrulate above, rounded at the base, abruptly beaked, the beak straight, 0.5 mm. long, bidentate, the teeth short, scabrous within.

Damp places in mountains, Costa Rica to Colombia and Ecuador. On Chiriquí Volcano, where it forms dense tussocks.

CHIRIQUÍ: Potrero Muleto to summit, Volcán de Chiriquí, alt. 3500–4000 m., *Wood-*

son & Schery 404; Loma Larga to summit, Volcán de Chiriquí, ca. 2500–3380 m., *Woodson, Allen & Seibert 1057*.

Fig. 43
Carex polystachya

2. Carex polystachya Sw. ex Wahl. Kongl. Vet. Akad. Handl. 24:149. 1803; Mackenzie, op. cit. *t. 265*. 1940.

Carex cladostachya Wahl. op. cit. 1803.
Carex mexicana Presl, Rel. Haenk. 1:204. 1828.
Carex Hartwegii Boott ex Benth. Pl. Hartw. 96. 1848.
Carex acrolepis Liebm. Dansk. Vid. Selsk. Skr. II. 5:270. 1851.
Carex Oerstedii Liebm. op. cit. 272. 1851.

Rootstocks woody; culms 25-60 cm. high; leaves numerous, clustered towards the base, the leaf blades thick, stiff, light green, long-attenuate, very rough, 2–7 mm. wide; spikes very many, in decompound panicles, androgynous, 5–9 mm. long, 3–4 mm. wide; scales ovate, many-striate, cuspidate to acute; perigynia narrowly obovoid, sharply triangular, not inflated, bright green, 2-keeled and many-nerved, stipitate, abruptly beaked, the beak strongly bidentate, half the length of the body or less.

Dry woodlands in mountains, West Indies and Mexico, southward to Peru. The inflorescence in Panama specimens is often much reduced (see fig 43).

chiriquí: El Boquete, *Hitchcock 8327;* Chiriquí Volcano, *Hitchcock* in 1911. coclé: El Valle, 600–1000 m., *Allen 747, 1169*.

3. Carex Humboldtiana Steud. Syn. Cyp. 208. 1855; Mackenzie, op. cit. *t. 264*. 1940.

Carex polystachya Sw. sensu Kuekenth. in Pflanzenr. IV^{20}:267. 1909.
Carex macrosperma Mackenzie, Bull. Torrey Club 36:477. 1909.

Rootstocks woody; culms 60–100 cm. high; leaves numerous, clustered towards the base, the leaf blades thick, stiff, light green, long-attenuate, 2.5–6 mm. wide; spikes very many, in 6–10 erect peduncled panicles, androgynous, 5–10 mm. long, 4–6 mm. wide; scales ovate, many-striate, short-awned to obtuse; perigynia elliptic-obovoid, sharply triangular, not inflated, bright green, 2-keeled and obscurely nerved, stipitate, abruptly beaked, the beak shallowly bidentate, half the length of the body or less.

Dry woodlands in mountains, Mexico to Brazil.

chiriquí: Chiriquí Volcano, *Hitchcock 8204*.

4. Carex Donnell-Smithii Bailey, Mem. Torrey Club 1:56. 1889; Mackenzie, op. cit. *t. 395*. 1940.

Carex Pittieri Boeckl. Allg. Bot. Zeitschr. 2:190. 1896.

Culms stout, 30–100 cm. high, purplish at the base; leaves numerous, the lower clustered, the leaf blades 3–10 mm. wide, glabrous, coriaceous, stiff, long-attenuate; inflorescence compound, 20–60 cm. long, the lower branches in 2's or 4's, the upper simple; spikes numerous, androgynous, narrowly linear-cylindric,

3–12 cm. long, 3.5–5 mm. wide, the pistillate part rather loosely 20- to 50-flowered; scales lance-ovate, usually rough-awned, purplish-black; perigynia lanceolate, 3.5–4 mm. long, membranaceous, dull green, scarcely inflated, punctic-ulate, 2-ribbed and strongly few-nerved, short-stipitate, abruptly beaked, the beak excurved, 1–1.5 mm. long, bidentate, the teeth stiffish, scabrous within.

In thickets, forest, or sphagnum bogs in mountains; Guatemala, Honduras, Costa Rica, Panama.

CHIRIQUÍ: El Boquete, *Killip 4528, 4546; Davidson 1044;* Chiriquí Volcano, *Hitch-cock 8212;* Bajo Chorro, *Davidson 146.*

Explanation of Plate

PLATE 1

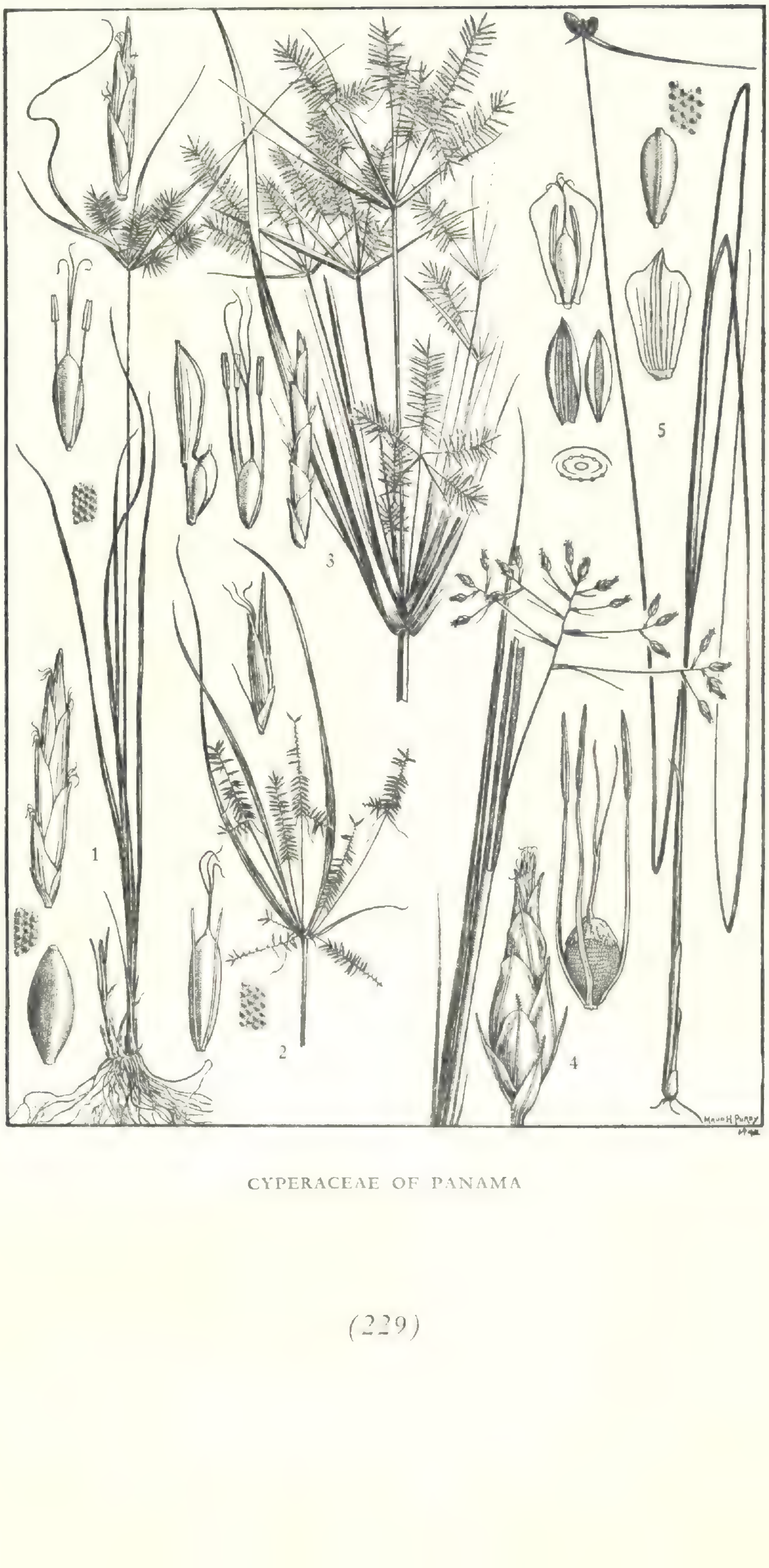
Fig. 1. *Cyperus tenuis*, showing an average small specimen (*Killip 4164*) and a mature spikelet and achene (1 a) of *C. hermaphroditus* (*Killip 4520*).

Fig. 2. *Cyperus tenuis*, a variant with somewhat reflexed spikelets (*Killip 4156*).

Fig. 3. *Cyperus ferax*, the large phase common in Panama, often with rachis-wings becoming corky only at late maturity, (*Woodson, Allen & Seibert 1571*).

Fig. 4. *Rynchospora robusta* (*Woodson 742*).

Fig. 5. *Lipocarpha Seloueana* (*Woodson & Schery 747*), showing a spikelet with the two inrolled inner scales removed from the achene and stamens, which are shown against the inner face of the subtending scale. Below, the position of these three scales is shown in diagrammatic cross-section of the spikelet.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MARGH PURDY

PALMACEAE

By L. H. Bailey

Woody perennial endogenous bland trees, shrubs and climbing vines (sometimes almost herbaceous), possessed of distinguished peculiarities and commonly recognized as a separate major botanical family yet lacking definite taxonomic morphological characters that pertain in all the species. The most characteristic general feature is the foliage: leaf-blades palmate and variously segmented, or elongated and pinnately veined or pinnatisect or pinnate, the leaf itself not long persistent and durable as in the cycads: blossoms very small, chaffy or soon becoming so, the envelopes in two series of calyx and corolla or simulating those organs, the parts or lobes valvate or imbricate in the bud, the staminiferous buds opening only briefly on disclosing the stamens and the flower then falling, pistilliferous buds exposing stigmas only a few hours: flowers hermaphrodite or unisexual, in the latter case the plant monoecious or dioecious, borne either on a simple spike-like spadix or in variously branched spadices or clusters always accompanied by more or less expanded scarious or foliaceous bracts or spathes; spadices usually interfoliar or infrafoliar, seldom in Old World species superfoliar and forming a top above the leaf-crown or coma; stamens prevailingly 6, as are the sepals and petals or lobes of the calyx and corolla, but sometimes 3, frequently many, anthers various; ovary superior, commonly 3-loculed and 3-ovuled but usually only 1 ovule developing; staminodia and pistillodia often present in flowers of the alternate sex: fruit little to very large, commonly 1-seeded and variously drupe-like, micropylar pore often marked on the exterior and in the Cocos tribes the two pores of the aborted locules also persisting and prominent, exterior fleshy and plum-like or fibrous or even coriaceous or parchment-like; seed ordinarily included in a shell-like mesocarp which is sometimes very thick and hard, often covered with extensive and involved branches of the raphe; seed content a soft or liquid substance that in most cases hardens into an endosperm, in which case the content may be ruminated by intrusions of a darker tissue from the walls, or the albumen homogeneous; embryo basal, lateral, apical, the placement usually characteristic of the genus.

A few thousand species of noble plants in many genera, growing around the world in tropical and warm temperate regions, some of them withstanding frost, inhabiting humid, intermediate and semi-arid places, in swamps, on plains and mountains and dry exposed savannas. Many of the species of the western hemisphere are imperfectly understood, and undoubtedly many novelties yet await discovery. Palms yield extensive materials for thatch, building timber, vegetable ivory, oils, fiber, and nutritious edible fruits or nuts as in the date, coconut, pejibaye. In warm countries they are extensively planted for ornament and comfort, yet frequently arranged and treated in poor taste.

TERMS SPECIALLY EMPLOYED IN PALM DIAGNOSES

acervulus (Latin, a little heap). Applied particularly in the palms to thin lines of flowers and fruits on a rachilla, pistillate flowers being at one end of the line; well represented in *Synechanthus, Gaussia, Mascarena.*

coma (Latin, the hair, head of hair). The leafy crown or head of a palm tree, particularly when the top is more or less condensed and high above the ground as in *Acrocomia, Euterpe, Roystonea.*

continuous. Said of albumen that is both solid (or without central cavity) and not ruminate.

costapalmate. Leaf-blade of the fan-shape or palmate kind that has a midrib and some of the segments divided to it, as in most species of *Sabal.*

crownshaft. The conspicuous elongated smooth false part of the shaft or trunk, composed of leaf-bases and inclosed terminal bud, that stands between the spadices and the coma in some palms, as in *Roystonea, Euterpe, Oenocarpus.* The spadices at its base stand in the axils of fallen leaves.

cymba (Latin, a boat). A spathe-valve that is heavy, woody and durable, and concave so that it incloses or accompanies the inflorescence and then the infructescence, applied particularly to the main secondary valve that remains on the tree, the primary or shorter cymba being early caducous, as in *Acrocomia, Cocos, Scheelea.*

endocarp. The inner layer or part of a pericarp; applied in palms to the osseous case in which the seed is often borne, when the case is not of the seed itself.

equable. Said of non-ruminate albumen: plane; homogeneous.

hastula. The ligule at apex of petiole of palmate leaves, at the base of blade.

homogeneous. Uniform, of the same kind throughout; said of non-ruminate albumen: plane.

infrafoliar. Below the leaves; applied to spadices that arise beneath the coma or leaf-crown.

interfoliar. Among the leaves; said of spadices that arise within the leaf-crown or among the leaves.

mesocarp. The middle part of a pericarp; applied to the content, usually soft, mucilaginous or fibrous, that lies between the endocarp and the nutlet; probably it represents different morphological structures.

nodifrond. The bract attending a flower-branch at each node of the spadix, applicable particularly in those spadices (as in *Sabal*) not accompanied by a cymba; sometimes called a spathelet.

nutlet. The hard nut-like center of the fruit, either the real seed itself or that body with its inseparable hard attached shell without reference to its derivation.

palman. The undivided part, like the palm of the hand, of a fan-shaped leaf, important in the diagnosis of certain species of *Sabal,* and designative in other palmate blades.

plane. Said of albumen when it is not ruminate.

rachilla. Ultimate branch of a compound spadix, on which the flowers and fruits are borne; less frequently applied to the axis of a simple spadix.

ruminate. Applied to albumen that is invaded by dark-colored protrusions from the walls, so that it is not homogeneous. The ruminate structure or its absence is an important diagnostic character.

sarcocarp. In a fruit, the external part or layer of soft or succulent substance, independently of its morphological origin.

spadix. The flowering and fruiting organ in a palm, whether simple or compound, fleshy or hard: inflorescence. This use of the term is often unfortunate even if supported by custom.

spathe. Large specialized bract associated with a spadix, particularly when expanded and apparently having structural relation to the flower-cluster. In practice with palms the term covers all the bracts and leafy organs subtending a spadix, even though this is a loose application of the word and will be corrected when good morphological investigations of the organs shall have been made. A *spathelet* subtends a branch of a spadix or inflorescence. In the cymba-like spathes the parts or *valves* are ordinarily

2, the primary or outer one falling usually in advance of flowering and infrequently observed, the inner longer and more durable one that commonly at first completely incloses the spadix or cluster: see *nodifrond, cymba.*

superfoliar. Above the leaves; said of spadices that are terminal, or arise above the crown, as in *Corypha,* an Old World palm sometimes planted; apparently none of the American palms presents this structure.

a. Leaves palmate or fan-shaped.
  b. Petiole ending at leaf-blade; trunk bearing thorns ..... 1. CRYOSOPHILA
  bb. Petiole extending nearly or quite through the blade as a midrib (at least in ours) and the blade with a marked downward curve in consequence: trunk not armed ..... 2. SABAL
aa. Leaves of the plumose kind with a continuing central rachis, pinnately veined or pinnatisect or pinnate.
  b. Fruit a large hard tuberculate rough shell lacking evident carpellary structure at maturity, inside which 1–9 large nutlets are borne.
    c. Species monoecious, both sexes on one spadix: spathe a woven cloth-like sheath that tears open at anthesis: fruits tessellate with small tubercle-like elevations ..... 27. MANICARIA
    cc. Species dioecious: staminate flowers in dense catkins with 2 cymba-like spathe-valves: fruits in strongly tubercled very large heads; seeds yielding vegetable ivory ..... 28. PHYTELEPHAS
  bb. Fruit wholly otherwise, smooth or only weakly spinescent or strigose, calyx and stigmatic point and usually the micropyle apparent on outside or on the seed.
    c. Exterior of fruit loricate, completely covered in thin flattened imbricate smooth glossy scales. ..... 26. RAPHIA
    cc. Exterior of fruit not loricate: fruit for the most part drupe-like even though the exterior is fibrous.
      d. Trunk or caudex long and very slender, not self-supporting, the plant a clambering or climbing vine ..... 6. DESMONCUS
      dd. Trunk heavy, essentially erect even if sometimes horizontal at base: trees or shrubs.
        e. Nutlet with 3 prominent pores or eyes (micropyles) at basal end underneath the fibrous covering; crownshaft not developed: spadices interfoliar (except in *Scheelea* and *Aerocomia*), branched (in ours); spathe usually of 2 woody cymbas (except in *Corozo* and perhaps *Aiphanes*), one of which persists and covers the inflorescence.
          f. Plant unarmed (except for spine-like undeveloped pinnae on lower part of rachis).
            g. Mature fruit very large, outer covering a thick spongy husk, nutlet containing liquid ..... 3. Cocos
            gg. Mature fruit size of goose egg or smaller, outer covering a close thin hard husk or integument.
              h. Spadix long and much branched, inside a heavy woody cymba: erect tree ..... 4. SCHEELEA
              hh. Spadix a dense head in axils, with fibrous shreddy covering: trunk prostrate at base ..... 5. COROZO
          ff. Plant armed with spines or prickles on trunk, petioles, cymbas or other parts.
            g. Pinnae long-tapering, acuminate, pointed.
              h. Trees large and heavy, boles usually variously tumid: main or permanent cymba elongated, very large and woody: staminate flowers somewhat or manifestly sunken in rachilla ..... 7. ACROCOMIA
              hh. Trees small with slender often flexuose trunks that are not swollen, frequently soboliferous or coloniate: cymba short, often nearly as broad as long at maturity, not woody: staminate flowers not sunken ..... 8. BACTRIS
            gg. Pinnae truncate or erose or strongly oblique at apex.
              h. Spathe-valves cymba-like, much elongated: staminate flowers compacted on short rachillae and sunken: heavy trees ..... 9. ASTROCARYUM

hh. Spathe-valves thin and narrow, not cymba-like or prominent: staminate flowers scattered on rachilla, not immersed: light slender trees.....10. Aiphanes

ee. Nutlet or seed with only 1 pore or micropyle developed, and even this one often covered under the epidermis: crownshaft often prominent: spadices interfoliar or infrafoliar, simple or branched: spathe various, in most cases not cymba-like.

f. Plant dioecious: rachillae marked with simple rather than triplicate scars where flowers or fruits have been: spadices vaginate, soon shredding and when fallen leaving rings on the peduncle: shrubs or very small trees.....11. Chamaedorea

ff. Plant monoecious, both sexes in same spadix: rachillae marked with 3 contiguous scars where flowers have been, pistillate depression in the center, or with 2 scars when one of the staminates has not developed: spathes not shredding: stature various.

g. Leaves regularly pinnate; pinnae uniform, narrow long-acuminate, divaricate from the rachis.

h. Flowers (and fruits) on branched spadices.

i. Tree attaining great height; trunk columnar, swollen at some part of its length: main cymba several feet in length, produced into a long beak: crownshaft very prominent: albumen plane: fruit a small more or less fleshy drupe.....12. Roystonea

ii. Tree of medium height (except in *Welfia* and *Euterpe*) and size or even small; trunk not swollen: cymba short, or spathe-valves bract-like: crownshaft evident or not: fruit and albumen various.

j. Rachillae drooping, not prominently expanded at base (at point of attachment).

k. Blossoms sunken partially or deeply on rachis.

l. Flower-strands or rachillae thick, stout and strongly angled, the flowers in 8 or more definite rows or lines: fruit ellipsoid: albumen plane: crownshaft not developed.....13. Welfia

ll. Flower-strands or rachillae very slender, not angled or cornered nor the pits in definite rows: fruit globose: albumen either plane or ruminate: crownshaft evident.....14. Euterpe

kk. Blossoms not sunken on slender more or less zigzag rachillae: fruit globose: albumen plane: crownshaft prominent.....15. Oenocarpus

jj. Rachillae divaricate or ascending, markedly expanded at base: albumen ruminate: crownshaft not developed.....16. Prestoea

hh. Flowers (and fruits) on simple spike-like spadices, continuing the line or direction of the peduncle: small palms.

i. Anthers sagittate, the 2 cells not disjoined: filaments free: spadix with a chaffy appearance due to long not sunken imbricate flowers.....17. Woodsonia

ii. Anthers imperfectly sagittate but the 2 cells separated on opposite sides of a continuing and projected connective: filaments connate at base: flowers sunken.....18. Neonicholsonia

gg. Leaves imperfectly or irregularly pinnate but the pinnae (if any) of different widths and sizes and ascending from the rachis as if divisions of a simple blade; or, the blade pinnatisect or entire with bifid apex; or, the blade or its lobes or divisions with oblique, truncate or erose ends.

h. Leaf divisions acuminate-pointed.

i. Inflorescence a small often overlooked broom-like spadix with very slender rachillae on the surface of

which the minute flowers are arranged in short lines or acervuli ..... 19. SYNECHANTHUS

ii. Inflorescence various but different from above and flowers not in acervuli.

j. Staminate buds at anthesis long and slender, not sunken in rachis ..... 20. HYOSPATHE

jj. Staminate buds short, sunken in rachis.

k. Anther-cells disjoined, separated by slender connective and spreading from points on a cup-like filament tube: leaves simple and bilobed or variously pinnatisect or irregularly pinnate: spadix simple or branched ..... 21. GEONOMA

kk. Anther-cells disjoined and hanging from top of filament tube: rachillae or spikes few and finger-like at top of slender ascending peduncle: blade of leaf simple, bifid at apex with 2 long points ..... 22. ASTEROGYNE

hh. Leaf divisions or leaf itself with erose, dentate or truncate expanded end.

i. Leaves long-pinnate or -pinnatifid, the pinnae or segments quaquaversal (standing in all directions or planes): fruits 2.5 cm. or more long: tall trees.

j. Stamens 9 or 10, or less than 20: spathes many .. 23. IRIARTEA

jj. Stamens usually more than 20, commonly 25–35: spathes of about 2 parts ..... 24. SOCRATEA

ii. Leaves entire and the blade more or less split or divided at its base: fruit a hard oblong body less than 15 mm. long: plant very small ..... 25. MALORTIEA

1. CRYOSOPHILA Blume. "Escoba"

CRYOSOPHILA Blume, in Rumphia 2:53, in nota. 1836.

Acanthorrhiza Wendl. in Gartenfl. 18:241. 1869; Bot. Zeit. 37:147. 1879.

Arboreous but not very tall fan-leaved single-trunk palms, with branching and more or less extensive root-thorns on the trunk or at least near the base of it but the plants devoid of true spines: leaf-blades glaucous or very thinly pubescent on lower surface, divided to near the base into many narrow segments: spadices interfoliar, briefly branched, usually shorter than the leaves, the clusters attended by broad and conspicuous papery more or less tomentose nodifronds: flowers hermaphrodite, the parts in 3's; petals free or connate; 6 stamens and 3 stigmas exserted from the more or less closed perianth at full anthesis, filaments united part of their length; ovary 3-loculed: fruit drupe-like, globose, oblong or short-pyriform, 2–3 cm. or less long, exterior fleshy but usually firm at maturity, containing commonly a single pea-like seed.

Five recognized species, Mexico to Panama. One of them, the Mexican *C. nana (Acanthorrhiza aculeata, A. Mocinii)* has been grown in palm houses.

a. Lower surface of leaf-blade finely but definitely appressed-pubescent, nerves not rusty, and also silvery: fruit more or less pyriform, often 2.5 cm. long ..... 1. C. WARSCEWICZII

aa. Lower surface of leaf-blade dull white-tomentose and usually also silvery, nerves brownish to rusty: fruit short-obovoid to globose, 17 mm. or less long ..... 2. C. ALBIDA

1. CRYOSOPHILA WARSCEWICZII (Wendl.) Bartlett, in Bot. Maya Area in Carnegie Inst. Wash. Publ. No. 461:38. 1935.

Acanthorrhiza Warscewiczii Wendl. in Gartenfl. 18:241. 1869; Drude, in Mart. Fl. Bras. 3: *tt. 132, 133* (non p. 554). 1882.

Slender erect tree sometimes to 12 or 13 m. but in forests often seen in much shorter stature, diameter of trunk above the enlarged base perhaps 8–10 cm.; root-thorns often 16 cm. and more long, deflexed but usually upwardly curved, passing into regular roots near the ground: leaves soft, 2 m. or more across, palmate, light green on upper surface, silvery and closely pubescent under a lens on lower surface; petiole slender, 2 m. or less long; hastula short, triangular-conic and blunt; main segments extending nearly to base of blade and 1 m. or so long, 2–7 cm. broad: spadix downward-curved, densely flowered, 60–70 cm. long, branching at nodes, the creamy-white long-acuminate nodifronds covering lower part of spadix-branches: flowers about 4 mm. long when open, nearly globular, crowned with the deflexed elongated anthers: fruit oblong-pyriform or only shortly narrowed at base, 3 cm. or less long, about 15 mm. thick, smooth and lucid.

Woods in Panama, of undiscovered distribution.

CANAL ZONE: Barro Colorado Island, *Bailey 110;* abandoned cacao plantation, Las Cascadas, near Summit, *Dodge & Hunter;* along Madden Road, *Bailey 558.*

Application of the name *Warscewiczii* is confused and untrustworthy, but the case cannot be worked out satisfactorily until the Cryosophilas of Panama are more fully collected.

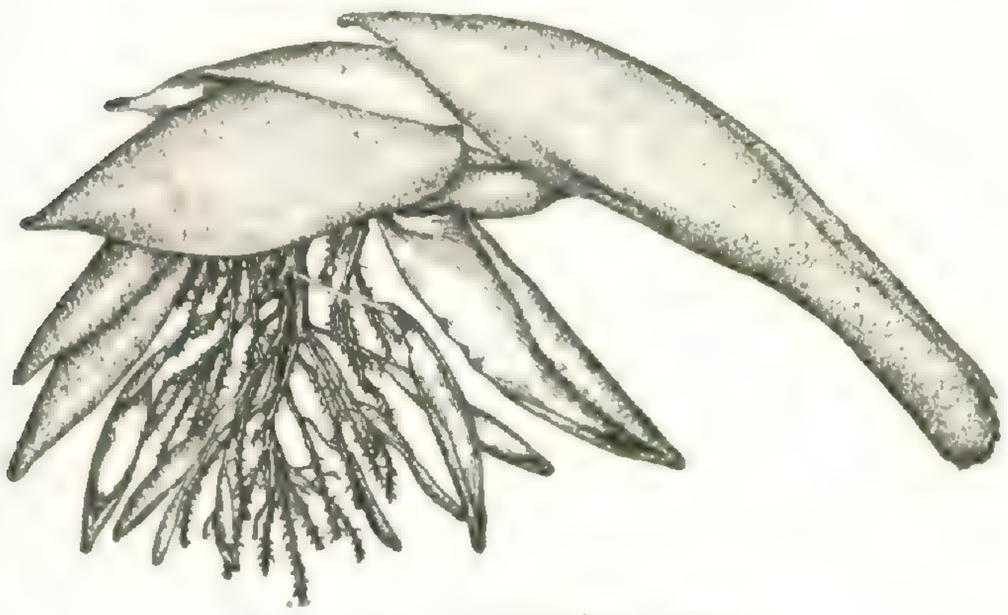

Fig. 44. *Cryosophila albida*

2. CRYOSOPHILA ALBIDA Bartlett, op. cit. 40. 1935.

Leaves dull tomentose underneath due to mixture of white and rusty hairs; nodifronds short, 10 cm. long, rather abruptly acuminate: fruit obovoid or subglobose, broad, 17 mm. or less in length, 14 mm. thick.

Costa Rica and Panama.

DARIÉN: near Boca de Pauarando on Sambú River (Bartlett, citing *Pittier 5688*). COCLÉ: north rim, vicinity of El Valle de Antón, *Allen 1902,* 3 m. tall.

2. SABAL Adans. "Palmetto"

SABAL Adans. ex Guersent, in Bull. Sci. Soc. Philom. (Paris) 3:205, *t. xxv.* 1804.

Spineless tree palms but the trunk sometimes rising little above the ground, base of the bole oblique, usually characterized by the essentially palmate leaf-blade through which a rachis (continuation of petiole) runs to the limit of the palman or undivided part, presenting a costapalmate structure and a curiously curved blade with the end of it declined toward the ground: spadices interfoliar, lacking a cymba but provided with conspicuous elongated green herbaceous

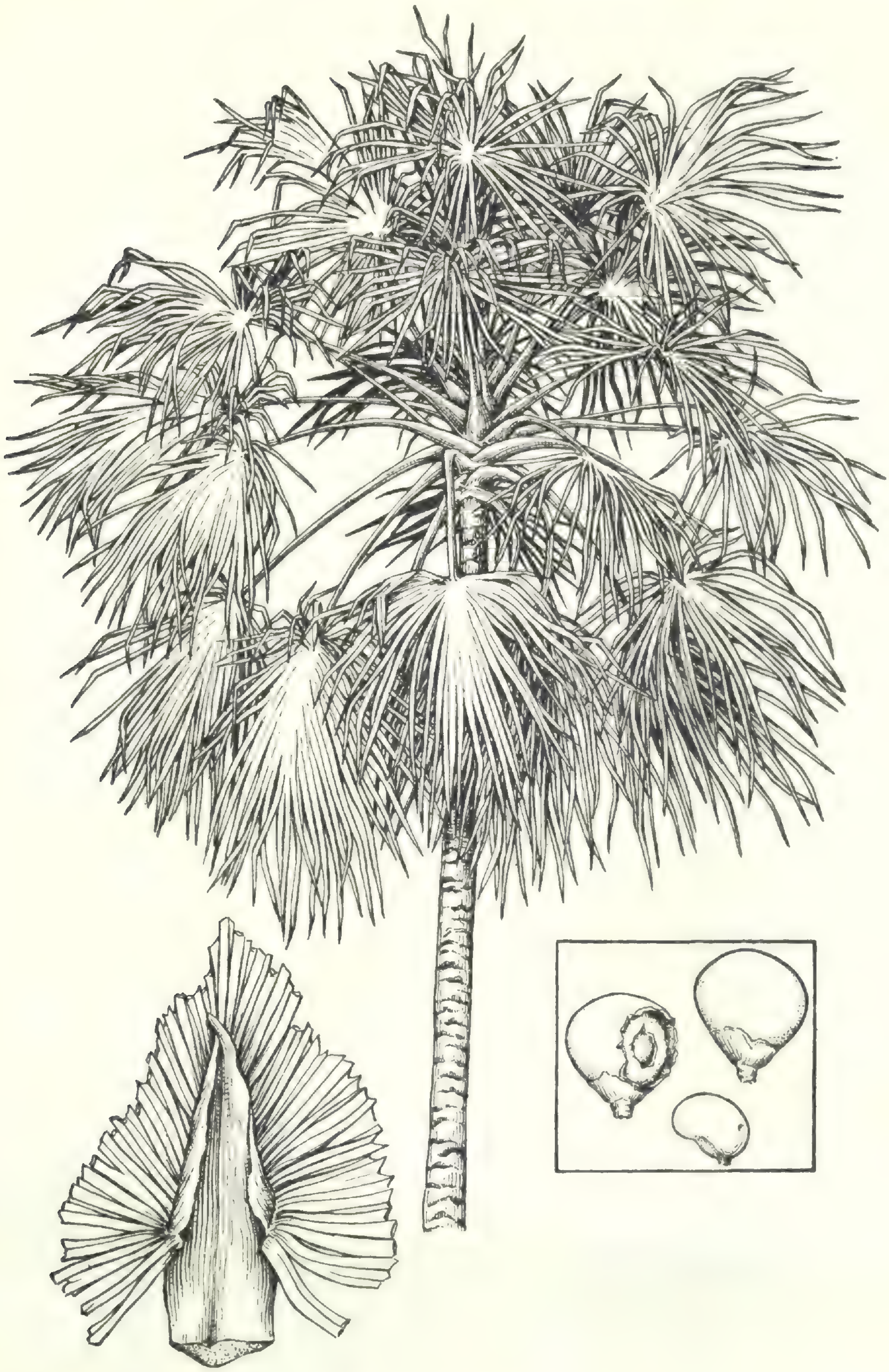

Fig. 45. *Sabal Allenii*

sheathing nodifronds: flowers hermaphrodite, parts in 3's; calyx tubular or parts united; petals 3, the narrow petals widely flaring or even reflexed; stamens 6, exserted in anthesis; carpels 3, style united, stigma usually not divided: fruit a hard nearly globular or oblate or pyriform body 25 mm. or less in transverse diameter; seed commonly 1 by abortion, micropyle lateral, in some species the mesocarp remaining as a fibrous envelope of the seed.

Western hemisphere, from North Carolina to northern South America; about 25 species now admitted. Many of the species are planted, some of which are not yet recognized in the wild; one species recently discovered in the Republic of Panama.

1. SABAL ALLENII Bailey, Gent. Herb. 6:200. 1943.

Slender erect palm to 20 m., trunk soon becoming bare and showing distinct rings, about 30 cm. diameter at base; crown about 15 m. above the ground on mature trees, consisting of 20–30 live leaves and usually 5–7 dead leaves hanging underneath (and piles of accumulated fallen leaves about the trunk): leaves to 2 m. across, thin in texture, glossy green on upper surface and much lighter-colored though not glaucous underneath, very deeply divided into 40 and more narrow ridged segments, without filaments, palman 30–45 cm. long beyond top of petiole; hastula 8–9 cm. in length, narrowly long-pointed, margins rolled in or incurved; segments 6–12 cm. across, 1.5 m. long and produced into very long and narrow or even almost thread-like extremities, soon divided into subsegments 2–4 cm. broad at base, the 1, 2 or 3 midribs strongly upstanding 2–3 mm. high, with secondary intervening ribs and furrows and then fine lengthwise parallel lines, many faint curved cross-lines that are more prominent underneath, surfaces glabrous: spadices erect, very open and diffuse, about equalling the leaves in length, the branches glabrous and striate, ultimate rachillae very slender and 6–10 cm. long, apices of nodibracts very acute or produced, sheaths striate: fruit glossy brownish-black, 8–10 mm. across at middle, sometimes twin, nearly globular to oblate and short-tapering to base so that most of the samples are somewhat pyriform, basal part scarified; seed contained in a fibrous mesocarp, dark brown, oblate, 5–7 mm. thick crosswise, glossy, depressed, faintly ribbed top to bottom, micropyle lateral.

Woods, Panama; on Pedro Gonzalez, Perlas Islands, where it was said to be confined, taken twice in 1941.

PANAMÁ: Perlas Islands, *Allen 2604*.

Leaves are commonly used for thatch throughout the Islands. Known as *Palma de Guagara*.

3. COCOS L.

Cocos L. Sp. Pl. 1188. 1753.

Trees with single usually leaning or oblique trunk becoming nude and ringed,

feather-leaved, spineless, monoecious: spadices interfoliar, shorter than the leaves, included at first within striate woody but not sulcate or furrowed large cymbas, the inner and longer one of which may persist as a dead object even after the fruit is grown; nodifronds reduced to scale-like bracts 2–4 cm. long that may have more or less perished by fruiting time: flowers staminate and pistillate, one of the latter normally standing between two of the others near the base of the strand or rachilla but the upper part of the strand staminate and many strands wholly staminate: fruit a great heavy indehiscent fibrous husk containing 1 hard-shelled nut that bears 3 prominent pores or micropyles at the end opposite the attachment to the tree, part of the contents remaining liquid; embryo basal; 3 inner envelopes of the staminate flowers much exceeding the 3 outer ones or calyx and lightly imbricate; envelopes of pistillate flowers very broad, striate, strongly imbricate.

As now defined, the genus is monotypic. Species of the western hemisphere formerly referred to it are segregated into other genera, none of which is known to be native in Panama.

1. COCOS NUCIFERA L. loc. cit. 1753. "Coconut."

Erect but not usually straight, being curved or bent in various ways, sometimes 30 m. tall, the bole seeming slender for the size of the crown: leaves bright green, very long, often 5–6 m. and more than 1 m. broad, the many single-ribbed but striate glabrous pinnae 4–5 cm. broad; petiole short and stout: spadices 1–2 m. long, conspicuously forking in axils of the leaves, the prominent yellow-white pointed caducous staminate flowers about 1 cm. long, pistillate flowers much larger: fruits few to several on a spadix, near the base of the branches, obtusely triangular, to 30 cm. or more long and more than one-half as thick, the nut itself 10–12 cm. thick but variable in size and bearing at its base 3 large eyes representing locules of the ovary.

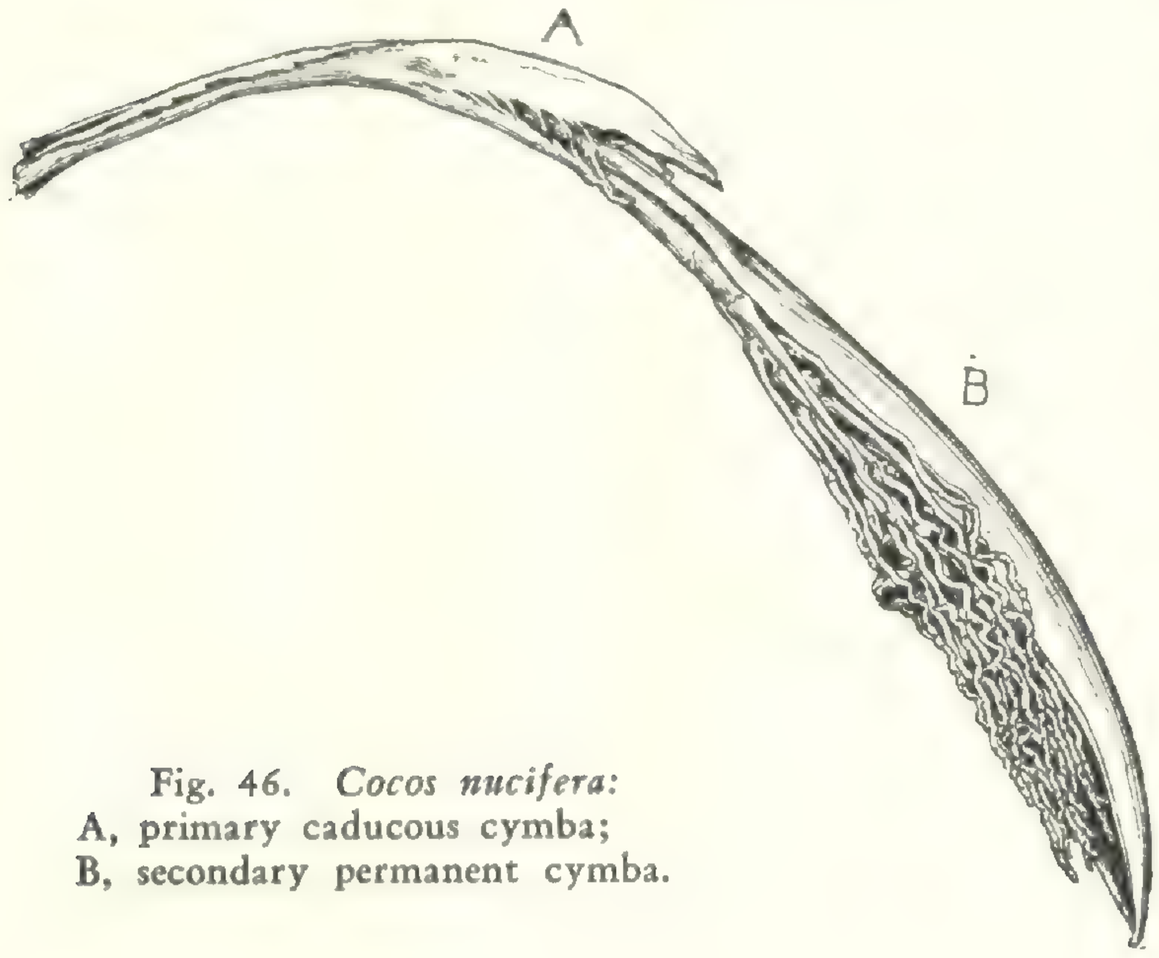

Fig. 46. *Cocos nucifera:*
A, primary caducous cymba;
B, secondary permanent cymba.

Attributed to Asiatic tropics but now spontaneous and wild around the world and constituting the palm scenery on the littorals of many lands; extensively planted for the yield of edible fruits. The products are many, as dried flesh or copra and fiber of the husk or coir. There are numbers of horticultural varieties.

CANAL ZONE: Chagres, Isthmus of Panama, *Fendler 424.*

4. SCHEELEA Karst.

SCHEELEA Karst. in Linnaea 28:264. 1856.

Heavy and often massive erect monoecious and polygamous spineless trees, with long large ascending pinnate leaves that make a great vase-form crown, trunk eventually becoming 15 m. or more tall but often bearing profusely when it is yet short and holding the leaf-bases, the denuded old bole marked with rough circular scars where the leaves were borne: spadices infrafoliar from lower part of crown, at first spreading but soon declined and in fruit usually pendent, the woody deeply sulcate main cymba often as long as a man, axis of cluster simple and bearing numerous simple side branches, in fruit becoming a ponderous hanging truss: staminate flowers usually occupying the upper length of the rachillae and pistillates the basal part but some trees bearing only staminates, others only pistillates and the bloom then not showy; floral envelopes 6, the 3 petals in staminate flowers terete and very narrow or even subulate, stamens 6, short and included; envelopes broad in pistillate flowers, imbricate, pistil 3-loculed and stigmas 3: fruit ovate or oblong, drupe-like but becoming a hard body with close fibrous covering and large accrescent calyx, although the mesocarp is mucilaginous at first, 1- to 2-seeded; albumen hard, continuous; embryo basal.

Species above 40, from Cuba and Mexico to Brazil, Peru and Paraguay.

1. SCHEELEA ZONENSIS Bailey, Gent. Herb. 3:36. 1933.

Ponderous tree, at maturity 10 m. and more tall and 2 m. in circumference at a meter above the ground: leaves standing more or less edgewise; petiole 30–60 cm. long; blade 5–6 m. long; rachis very stout, double-furrowed above; pinnae stiff, 1 m. or more long and 4–6 cm. broad, more or less furfuraceous, midrib very strong but intermediate veins faint: staminate flowers ochroleucous at anthesis, much frequented by insects: great outer cymba 2–3 m. long: fruit oblong, 6 cm. or more long including calyx, 3 cm. thick, beak 7–8 mm. long, surface brown, smooth and closely striate when dry, 1-seeded, the nutlet covered with a hard thin fibrous husk.

Common tree across the Canal Zone and neighboring territory, its general distribution unreported; in low or moist places and in woods. One of the species known as *Palma Real*.

CANAL ZONE: Barro Colorado Island, by lookout tower, *Bailey 1;* Fairchild Trail, *Bailey 14*.

This is the palm long known on the isthmus as *Attalea Cohune* (now *Orbignya Cohune* Dahl.) and *A. gomphococca*. The former (*A. Cohune* Mart.) was first based on indefinite records of a palm cultivated in England and supposed to come from Honduras; it is attributed to Mexico and other regions, and the name is frequently erroneously applied to planted trees. *A. gomphococca* Mart. was likewise based on lists of plants in cultivation in England and supposed to have come from Central America but without definite locality. It has recently been transferred as *Scheelea gomphococca* (Mart.) Burret. The species is not understood.

5. COROZO Giseke. "American Oil Palm"

Corozo Giseke, in L. Praelect. 42. 1792.
Alfonsia HBK. Nov. Gen. et Sp. 1, fol. ed.:245; quarto ed.:30. 1815.

Monoecious tree with trunk reclined or prostrate part of its length and producing roots along its straight or curved course, then upright a few feet and bearing a heavy crown of ascendate pinnate leaves free of the ground but the dead leaves hanging and broken: flowers staminate and pistillate in the same crown, in dense sessile heads in leaf-axils; staminate flowers in dense finger-like catkins in clusters at apex of peduncle and that soon perish; spathe soon becoming a mass of separating fibers; stamens 6, filaments connate; pistillate flowers sunken in the rachis of thick spikes that are compacted into a heavy durable head; ovary 3-celled, but usually only 1 carpel developing: fruit oblong or pyriform, drupe-like.

Central America to Amazon region, perhaps more than a single species.

1. Corozo oleifera (HBK) Bailey, Gent. Herb. 3:59. 1933; 4:373. 1940.
Alfonsia oleifera HBK. loc. cit. 1815; Cook, in Nat. Hort. Mag. 19:20. 1940.
Elaeis melanococca Auth., non Gaertn.

Trunk lying few or several meters on ground as if creeping, upright part to 2 m. high and bearing ragged covering of old persisting leaf-bases: leaves long, regularly pinnate, ascending and finally spreading; petiole 1–2 m. long, the two sharp edges bearing spine-like teeth and undeveloped pinnae; blade 2–3 m. or more long, closely set with 60 or more pairs of pinnae which are 1 m. or more long and 5 cm. or more broad at middle, glabrous, prominently ribbed and parallel-veined: staminate catkins 20–25 cm. long and about 1 cm. thick; pistillate head 30–40 cm. long at maturity, consisting of many compacted spikes 10–18 cm. long, and each one ending in a black acute projection: fruit oblong, 3–4 cm. long, abruptly acute at apex, sitting in the shallow cup of the accrescent calyx, black at full maturity but preceded by orange.

Moist and swampy places, probably widely spread in Panama, known in the Zone from swamps of Colon Bay to open fields at Old Panama; the South American and Costa Rican extensions are supposed to be the same species. The fruits provided oil and tallow to early colonists. Until recently it was assumed that Gaertner's *Elaeis melanococca* is this species but it is undoubtedly only a fruit variant of the African oil palm, *Elaeis guineensis*, which is spontaneous in some parts of the western hemisphere and is also frequently planted for interest and ornament. The American oil palm is one of several species in different genera known in the vernacular as *Corozo*.

CANAL ZONE: near Fort Sherman, Bay of Limón, *Bailey 216*.

6. DESMONCUS Mart.

Desmoncus Mart. Hist. Nat. Palm. 2:84. 1824. *Nomen conservandum.*

Atitara Juss. in Dict. Sci. Nat. 3:277. 1804. *Nomen rejiciendum.*

Slender climbing or clambering pinnate-leaved monoecious palms supported by spine-like modified pinnae and sometimes by hooked prickles on rachis and under-surface of leaves; pinnae alternate or opposite or multiple, the rachis ending in one or more sets of nodal leaf-spines pointing backwards and that are often bulbous at base, the end of the leaf often long and tendril-like: spadices interfoliar, short, once-branched, covered by 2 cymbas of which the interior one is large and more or less persistent and spiniferous or hairy or both on the exterior: staminate flowers occupying the upper part or the ends of the slender simple rachillae, stamens 6, pistillode sometimes present, calyx minute; pistillate flowers mostly near base of rachilla but sometimes occupying nearly all of it and the plant perhaps functionally more or less dioecious, ovary 3-loculed, stigmas 3: fruit small, drupe-like although the exterior is scarcely fleshy, ovoid or subglobose, 1-seeded, with 3 pores; seed with homogeneous albumen.

Species 40–50, Mexico, Central America, West Indies, South America, on bushes and often ascending tall trees. The hairy and spiny cymbas are often conspicuous as they hang.

Undoubtedly more than one species of *Desmoncus* is in Panama, but collected specimens are too imperfect to allow of determination. *D. chinantlensis* Liebm. of Mexico has been suggested as the name of one of the Panama collections, but this disposition is at least doubtful.

1. Desmoncus isthmius Bailey, Gent. Herb. 6:211. 1943.

Long trailer and climber; trunks 1–2.5 cm. thick, glabrous and nude: leaves 2 m. long, with many large alternate pinnae becoming opposite on the upper part where they pass into 3 or 4 pairs of retrorse glabrous strong heavily based spines 3.5–4.5 cm. long; petiole and rachis sharply angled, glabrous or at places slightly furfuraceous, bearing a few straight spines 1–2 cm. long with now and then a stout broad-based sharp curved hook 3 mm. long; leaf-sheath many-striate and bearing many dark brown flat spines 5 mm.–2.5 cm. in length; pinnae long-lanceolate-acuminate, 15–24 cm. long, 2.5–4 cm. broad at middle, glabrous on both surfaces or with a trace of puberulence underneath, margins unarmed, midrib pronounced but the several side-veins indistinct, upper surface sometimes marked by elevated cross-lines, usually a spine 1.5–2 cm. long borne on midrib underneath at about the middle or toward the base: main or inner cymba 24 cm. long, 5–6 cm. broad, densely covered with blackish white-bottomed spine-like setae 1 cm. more or less long; primary spathe short and narrow; sheath of openly woven fibers and many blackish spines; spadix at anthesis 12–15 cm. long and 10 cm. broad, the glabrous rachillae later extending and likely to be fertile to the ends: fruit ellipsoid, nearly or quite 2 cm. long when dry and 8 or more mm. broad, abruptly pointed, glabrous; cupule not very prominent, inner series undulate or lightly indented and much more extended than the small ring-like calyx; seed 13–14 mm. long, 6 mm. thick, narrowly oblong, closely reticulated with light-colored rapheal lines

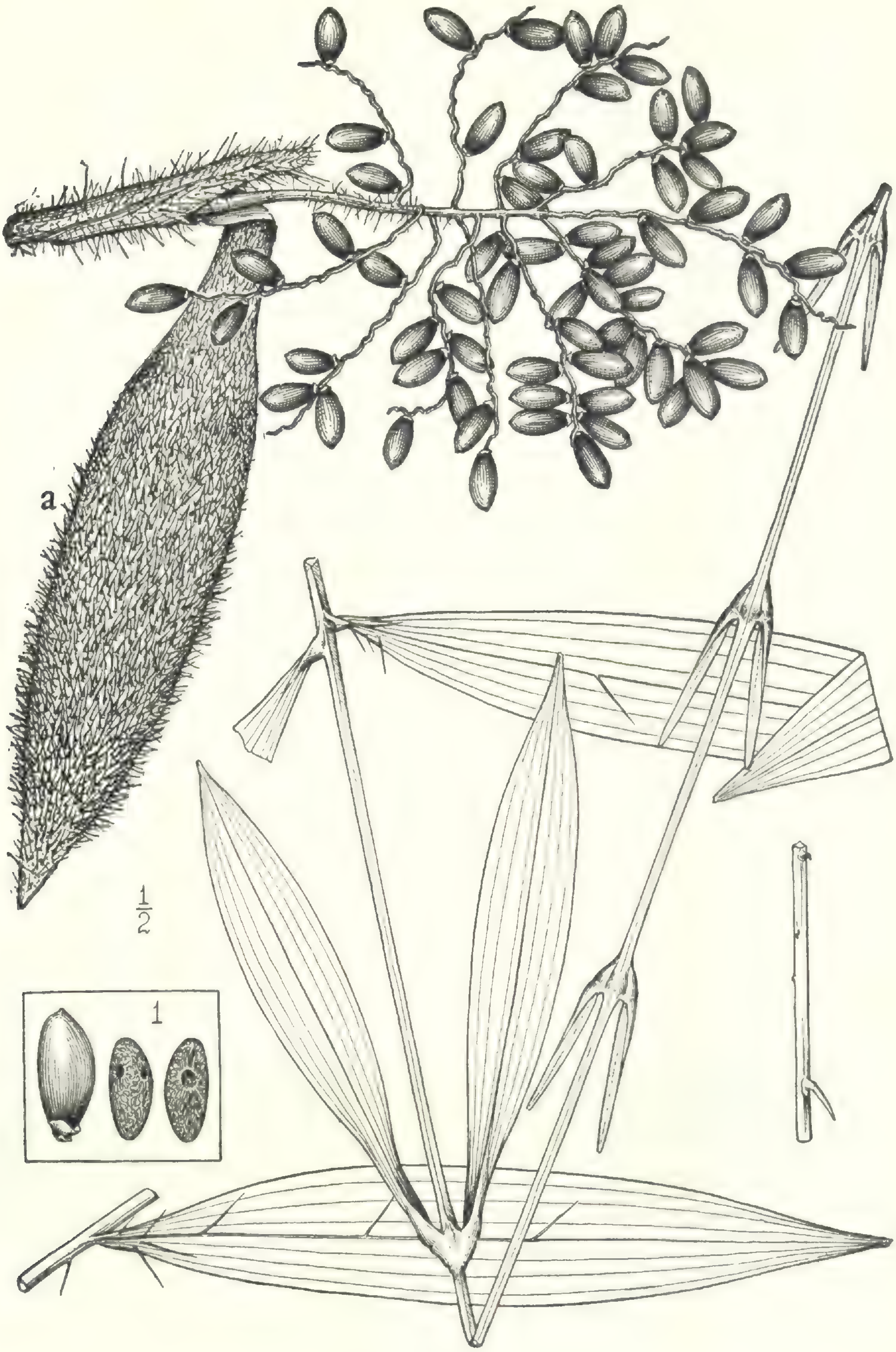

Fig. 47. *Desmoncus isthmius*

issuing from the central micropyle that attaches to the outer shell of the fruit, and 2 pores prominent on the back.

PANAMÁ: Marraganti and vicinity, *Williams 691*. CANAL ZONE: Chivi-Chivi Trail, two miles above Red Tank, *Maxon & Harvey 6573*.

7. ACROCOMIA Mart. "Gru-gru"

ACROCOMIA Mart. Hist. Nat. Palm. 2:66, *tt. 56, 57*. 1824.

Tall single-trunked monoecious pinnate-leaved trees, very spiny (one exception) on bole and petioles and cymbas and sometimes on fruits; spines long and slender, commonly flattened, expanded or cushioned at base, usually black or at least very dark, not stiffly attached: leaves very long, becoming horizontal and drooping, with very many pairs of narrow hanging long-pointed pinnae, commonly glabrous on the upper surface but often indefinitely pubescent on upper surface; petioles prickly on outer convex surface: spadices infrafoliar, consisting of a long central axis and short mostly simple side-branches or rachillae; cymbas 2, outer or primary one soon caducous, inner one persistent and often hanging as a dead body long after the fruit has fallen: staminate flowers 5–7 mm. long, occupying most of the length of the rachillae and partially sunken in it, stamens 6; pistillate flowers at the angles on the base of the rachilla, about 10 mm. long, partly immersed, ovary 3-celled: fruit a drupe-like body size of a walnut, 1-seeded by abortion, olive-green or yellowish, 3–4 cm. transverse diameter, mesocarp mucilaginous with fibers running through it (sometimes edible) and that dries to a cork-like interior that stoutly adheres to the nut; rind becoming thin and then brittle as an egg-shell; nutlet conical to almost globular, with 3 eyes or micropyles, albumen hard and continuous.

About 25 species of conspicuous ornamental trees, often planted, native from Cuba and Mexico to Argentina and Paraguay.

Acrocomia divides itself into two sections on the nature of the trunk, and although the differences are striking they are seldom brought out in photographs and have not been recognized until recently. In Section Tectocomia, to which the single Panama species belongs, the bole is covered with broad petiole-bases on which most of the spines are attached; these bases or boots remain for several or many years, finally rotting away and leaving a naked bole with deep notch-like ring, or steps, most of the spines disappearing with them. In Section Sentocomia the trunk is soon divested of the caducous petioles; the bole then is marked by shallow rings intervening between circling rows of spines.

1. ACROCOMIA PANAMENSIS Bailey, Gent. Herb. 4:444. 1941.
A. vinifera Auth., non Oerst.

Variable in height, often fruiting on dry land when less than 2 m. tall but the tree eventually reaching 8 m., the bole at first densely clothed with spiniferous leaf-bases; crown of 10–15 leaves; petiole bearing black sharp spines 2–10 cm. long; pinnae 2–3 cm. broad, glossy and glabrous on upper surface but gray and

puberulent underneath: main or persistent cymba about 1 m. long, coarsely tomentose and somewhat spiny: fruit nearly or quite globular or somewhat flattened end-wise, about 3.5 cm. transverse diameter, covered with caducous floccules and crooked hairs, the mature fresh surface cream-colored with greenish tinge.

Panama: frequently remaining on properties when the land has been cleared. Known as *Pacora.*

CANAL ZONE: Balboa, *Allen 2213.* PANAMÁ: near Panama City, *Bailey 552;* near Bella Vista, Panama City, *Bartlett 16977.* VERAGUAS: in groves near Ocú and Santiago, *Allen.*

8. BACTRIS Jacq.

BACTRIS Jacq. Select. Stirp. Amer. Hist. 1:279. 1763.
Augustinea Karst. in Linnaea 28:395. 1856.
Pyrenoglyphis Karst. Fl. Columb. 2:141. 1866.

Small bushy erect or sometimes semi-procumbent monoecious palms, in some cases more or less tree-like, most of them very spiniferous, commonly soboliferous from short rootstocks, spadices interfoliar, spines usually borne on all parts except perhaps on flowers and fruits: spadices short and covered in two spiniferous cymbas one of which is persistent: leaves pinnate or pinnatisect or pinnately lobed, the parts standing in one plane: spadix a single unbranched compact spike like an aroid within its spathe or in other cases with short simple spreading branches bearing pistillate flowers on lower part and staminates on the upper part although typically with a pistillate between 2 staminates, not sunken in the rachis, floral parts a calyx of 3 sepals or lobes, petals same; staminate flowers with urceolate or cup-like calyx that enlarges in fruit, petals or corolla-lobes much larger, valvate, stamens 6–12, pistillode very small or absent, the full staminate bud often angular from compression; pistillate flowers usually smaller, ovary 3-loculed, stigmas 3 and mostly conspicuous at moment of anthesis: fruit drupaceous, small, globular or oblate or pyriform or turbinate, mostly less than 5 cm. long, 1-seeded, mesocarp more or less succulent even though thin and usually of little substance, mealy or fibrous when dry, exterior cream-white or yellowish, orange or reddish or purplish and sometimes aculeate or setose but the armature commonly soon vanishing; floral envelopes accrescent and forming a cupule at base of fruit, sometimes the lobes in each series separate and in other cases the series constituting a double crenate cup; nutlet with 3 prominent pores one of which is functional; albumen hard and homogeneous; raphe represented usually in reticulations.

Tropical western hemisphere, from Cuba and Mexico to South America, nearly 200 species recognized, in many habitats. Accounted a difficult genus in identification but not inexplicable when proper specimens are available.

Related genus is *Guilielma* which is native in Costa Rica and the same or a similar species in Colombia and southward, but not reported as a native palm in Panama although frequently planted. The genus is included in *Bactris* by many

authors but the habit of the plant and general features are so unlike that the two may well be held apart. *Guilielma* is distinctly tree-like even though somewhat soboliferous, pinnae linear and acuminate and commonly standing in more than one plane on the rachis, fruit a large highly colored fleshy edible drupe known as *Pejibaye, Chonta, Gachipaes, Peach Palm* and by other names. The plant in Costa Rica is known as *G. utilis* Oerst. and in Colombia and Brazil as *G. Gasipaes* (HBK.) Bailey (*B. speciosa* Mart.)

a. Leaves simple, consisting of a pinnately veined blade deeply bilobed at apex: plant soon becoming nude from the weathering away of the few weak spines ..... 1. B. PAULA

aa. Leaves pinnate, with distinct and separate leaflets or pinnae either side the rachis: plant permanently spiniferous.

b. Foliage conspicuously yellow-pilose on both surfaces and rachis ..... 2. B. ALLENIANA

bb. Foliage glabrous, or sometimes inconspicuously puberulent (under a lens) on one surface or the other.

c. Species with bright green glossy leaves not rigidly and closely costate (main secondary veins 8–10 mm. apart), sides curving and not parallel for any distance, apex prominently acuminate and often caudate, margins nude or not conspicuously setulose.

d. Petiole devoid of spines except at base, as also the rachis.

e. Pinnae 30 cm. and more long: fruit black; cupule crenate ..... 3. B. COLONIATA

ee. Pinnae less than 20 cm. long, very glossy: fruit orange; cupule without crenate border ..... 4. B. AUREODRUPA

dd. Petiole spine-bearing throughout its length; rachis also sometimes spiniferous.

e. Pinnae short-caudate or only acuminate, marked on upper surface with cross-lines between the nerves: cupule of an outer series (calyx) of 3 deep lobes and an inner series (corolla) with nearly entire margin and setose ..... 5. B. FUSCOSPINA

ee. Pinnae long-caudate and no elevated cross-lines: cupule divided into deep lobes in both series ..... 6. B. DIVISICUPULA

cc. Species with gray-green mostly not glossy foliage; pinnae strongly marked with close usually parallel nerves (close and thin in *B. oraria*, not deeply parallel in *B. superior*), margins manifestly setulose.

d. Upper surface of pinnae conspicuously marked with elevated cross-lines between the main nerves (tessellate or reticulate).

e. Petiole spine-bearing only at or near base, some of the spines 15 cm. long: fruit dark green becoming orange-red, hairy; cupule shallow and flat ..... 7. B. BARRONIS

ee. Petiole armed throughout, the spines 5 cm. or less long: fruit deep orange, smooth; cupule shallow, lightly crenate ..... 8. B. COLORADONIS

dd. Upper surface of pinnae lacking manifest elevated cross-lines: outer ring of cupule flat, scarcely cupulate.

e. Pinnae short and narrow, mostly 20 cm. (sometimes 30 cm.) and less long, often less than 1 cm. broad, parallel veins all thin, sides parallel: plant often procumbent or clambering: shores (orarian) ..... 9. B. ORARIA

ee. Pinnae much larger, the rib and side-veins making ridges lengthwise: plant erect: mostly inland.

f. Shape of pinnae broad in middle (about 4 cm.) and narrowed either way; rachis sparsely tomentose to glabrescent: fruit 4–5 cm. long, apex conic ..... 10. B. SUPERIOR

ff. Shape of pinnae about the same width throughout their length (except of course at ends), 2–3 cm. or less broad; rachis of leaf rusty-tomentose.

g. Attachment of pinnae 3–5 cm. apart, giving the leaf an open look: fruit oblong or acorn-like, 4 cm. long, with somewhat parallel sides ..... 11. B. BALANOIDEA

gg. Attachment of pinnae close together, giving the leaf a crowded and continuous look.

h. Petiole devoid of hispid hairs; apex of pinnae not long and narrowly acuminate: fruit globular-oblong, about 4 cm. long, with curving sides, not becoming peaked in drying ..... 12. B. AUGUSTINEA

hh. Petiole beset with hispid hairs among the spines: pinnae slenderly acuminate: fruit ellipsoid or elliptic-ovoid, 4–5 cm long, peaked when dry ..... 13. B. MAJOR

1. BACTRIS PAULA Bailey, Gent. Herb. 6:226. 1943.

Very slender with 3–6 or sometimes 10 culm-like stems or canes in a group or colony, 2–2.5 m. tall; trunk or cane less than 1 cm. thick, glabrous and smooth, nodes 4–5 cm. apart; plant bearing a few slender spines that soon weather away, leaving it nude: leaves usually 3 to a culm and near the top of it, simple but deeply bilobed, soft-pubescent underneath, glabrous above and with broken cross-lines between the many prominent veins, midrib lacking on the lobes or divisions; lobes of leaf 25 cm. long and 7–8 cm. broad, apex long-acuminate, margins with apiculate points; petiole 5–8 cm. long, scurfy-pubescent as well as the rachis; leaf-sheath narrow, striate, pubescent: cymba 8–9 cm. long, about 3 cm. broad at maturity, thinly covered with setose white-bulbous brown hairs: fruit globular, beak short, bright red or orange-scarlet, about 12 mm. diameter.

Panama.

COCLÉ: heavy forest, where it is infrequent, vicinity of La Mesa, El Valle de Antón, alt. about 1000 m., *Allen 2567;* hills north of El Valle de Antón, trail to La Mesa, *Allen 2695.*

2. B. ALLENIANA Bailey, Gent. Herb. 6:228. 1943.

Trunks few to several, 3 m. tall and about 2.5 cm. thick at base, arundinaceous or cane-like, the prominent nodes about 6–8 cm. apart, with scattered very thin spreading spines 1–2 cm. long, canes pithy in cross-section: mature leaves 3–4 at apex of each cane, 1.5–2 m. long, soft or thin in texture, evenly pinnate, both surfaces and rachis conspicuously hirsute and exposing a golden glint in sunlight; pinnae opposite and alternate, 30–40 cm. long, 3–4 cm. broad, apex produced into a very slender tail-like extension, midrib not very prominent and attended on either side by 3 or 4 strong side-nerves, hairs numerous but particularly prominent on veins underneath, spineless; rachis very hirsute and bearing many light-colored white-based spines 2–5 cm. long, and which may be somewhat longer and more conspicuous on the petiole; leaf-sheaths conspicuously long, tightly clasping the cane, armed with both dark-colored and light-colored weak spines: cymbas or spathes attached among old leaf-bases on under side of crown, 15–20 cm. long, very densely woolly with tawny hairs 1 cm. and more long, the small outer or primary cymba little or not at all hairy; flowering spadix dense, about 10 cm. across either way, with very many slender rachillae; staminate flowers pedicelled: fruit oblate, 10–12 or more mm. across, flat on top, beak prominent, unarmed, glabrous, striate; cupule shallow, with few obtuse lobes.

Panama.

COCLÉ: hills north of El Valle de Antón, alt. about 700 m., *Allen 1804, 2574, 2951,* in deep shade.

3. BACTRIS COLONIATA Bailey, Gent. Herb. 3:106. 1933.

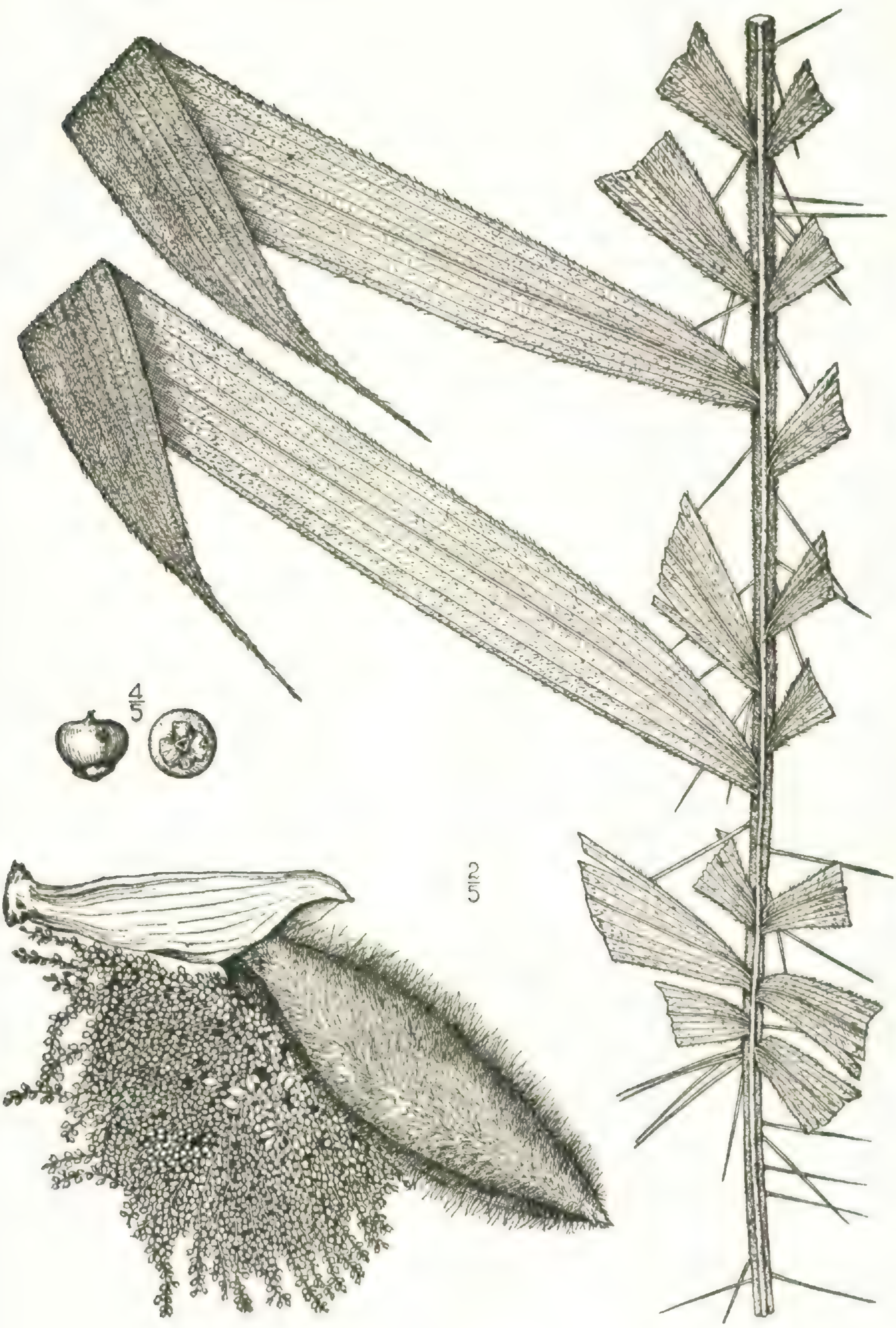

Fig. 48. *Bactris Alleniana*

Graceful and slender, growing in open but not crowded large colonies; trunk 3–6 m. tall, about 4 cm. thick, irregularly ringed with brown-black bulbous-based spines 3–8 cm. long that are ascending on upper parts of bole and more or less declined on lower parts, the intermediate blank spaces often as much as 15 cm. long, the plant spreading by means of subterranean stems: leaf-blades 2 m. more or less long, glossy, thin in texture, interruptedly pinnate; petiole 1 m. or more long, slender, sometimes furfuraceous, nearly terete, bearing light-colored spines 1–3 cm. long toward the base and otherwise unarmed, rachis usually unarmed; pinnae about 25 subopposite pairs spaced 5–8 cm. apart, to 75 cm. long and 4–5 cm. broad, glabrous, midrib prominent and side-veins sometimes nearly equally so, margins minutely setulose, apex prolonged into a narrow nearly or quite caudate part, this part particularly slender and conspicuous on the broad pinnae of young plants: cymba or spathe 20–30 cm. long, densely brownish or tawny-setose: fruit turbinate, 2–2.5 cm. long, black, with abrupt short stout beak, glabrous; cupule double with bluntly scalloped edges; nutlet about 12 mm. either way, flattened on top, contained within a fibrous mesocarp.

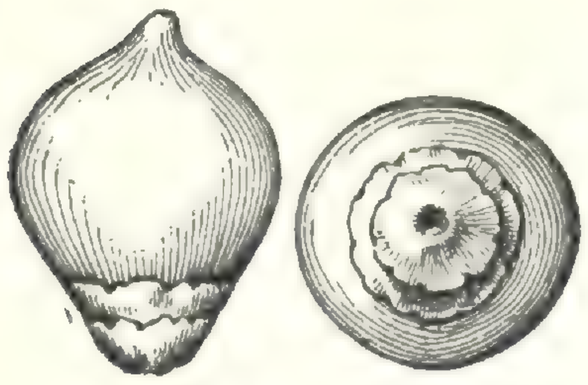

Fig. 49
Bactris coloniata

Panama; called *Uvito*.

CANAL ZONE: woods, Barro Colorado Island, on dry land.

4. BACTRIS AUREODRUPA Bailey, Gent. Herb. 6:232. 1943.

Very slender palm, 3 m. tall; trunk arundinaceous, 1–2 cm. thick, bearing a few small blackish thin spines; leaf-sheaths 20 cm. or more long, closely clasping, armed with very thin spines 1–2.5 cm. long: leaves about 1 m. long, pinnae irregular in attachment, very glossy on under glabrous surface, less glossy on duller upper surface which also discloses a very close puberulence under a lens; pinnae 14–16 either side the slender puberulent rachis, with alternate attachment toward apex but scattered on lower part, unarmed but perhaps a spine or two on the petiole, the pinnae thin in texture, 16–20 cm. long and 2–2.5 cm. broad, long-acuminate and very sharp, midrib not very prominent and accompanied by conspicuous nerves on either side, margins hispidulose: cymba 10–14 cm. long, appressed on middle with short blackish setose hairs: fruiting spadix 7–9 cm. across either way, rachillae lightly pubescent: fruit pyriform, 12–14 mm. long, 9–10 mm. thick, glabrous, orange, beak so small as to be hardly noticeable; cupule about 3 mm. deep, with almost continuous and only notched or broken edges.

Panama.

COCLÉ: hills north of El Valle de Antón, alt. 1000 m., *Allen 2150*.

5. BACTRIS FUSCOSPINA Bailey, Gent. Herb. 6:228. 1943.

Slender, leafy, arundinaceous, 3 m. tall; trunk 1.5–2 cm. thick, pithy, nodes about 5 cm. apart and usually spiny on at least one side, internodes nearly or quite nude, main spines mostly brown-black and 2–3 cm. long: leaves 1 m. and more long, glossy, glabrous, unequally and abruptly pinnate; petiole more or less scurfy

or furfuraceous, very unevenly armed on the sheath with brown and tawny spines 5 mm.–3 cm. long; rachis glabrous or with traces of furfur, bearing on the lower part and petiole many broad tawny dark-tipped reflexed spines 4–4.5 cm. long; pinnae 12–16 either side the rachis, alternate and with long unoccupied spaces, 20–25 cm. long, 2.5–9 cm. broad, the terminal pair much the broadest, midrib often not definite, other ribs few to several and very prominent and with indistinct cross-veins between them on the upper surface, margins unarmed, apex acuminate and sometimes short-caudate: cymba 15–20 cm. long, narrow, densely covered with tawny spines 2 cm. or less long: fruiting spadix 10 cm. long and broad, rachillae indifferently pubescent: fruit (immature) oblong-conic, prominently beaked, glabrous; cupule 5 mm. deep, outer series of 3 nearly separate striate lobes, inner series deeper and urceolate with a nearly entire margin and the exterior prominently strongly setose (the setae likely to perish with handling).

PANAMÁ: Cerro Campana, *Allen 2086.*

6. BACTRIS DIVISICUPULA Bailey, Gent. Herb. 6:230. 1943.

Slender, 4 m. tall; trunk arundinaceous, 2.5 cm. or less thick, pithy in center, nodes 6–7 cm. apart and the intervals nude; leaf-sheaths long and tightly closing and thickly provided with brownish-white black-based flat spines 3 mm.–4 cm. long: leaves glossy and glabrous, 1 m. or less long, irregularly pinnate, bearing flat spines between the pinnae on some parts of the rachis, and the pinnae sometimes few; pinnae 30–40 cm. long, some of them 4–5 cm. broad and others (particularly the terminal pair) as much as 9 or 10 cm. broad, apex slenderly caudate, the 5–7 prominent nerves widely spaced and the midrib not much more prominent than they; rachis nearly terete, glabrous except for indistinct lines of furfuraceous pubescence: cymba maturing often below the falling leaves, 15–20 cm. long, densely clothed with tawny flat prickles 2 cm. or less long: fruiting spadix short, 8–9 cm. across either way, the few short branches or rachillae pubescent; fruit oblate-pyriform, 11–14 mm. thick, top flat, beak pronounced, surface glabrous and when dry faintly striate, thin mesocarp adhering tightly to the large nutlet; cupule strongly divided into broad lobes or parts in each series.

Panama.

COCLÉ: northwest rim of El Valle de Antón, alt. about 600 m., *Allen 1817.*

7. BACTRIS BARRONIS Bailey, Gent. Herb. 3:101. 1933.

Low or intermediate, 2.5–8 m. tall, in small clumps (sometimes only 2 or 3 or 4 boles); trunk 4–6 cm. thick, conspicuously ringed with black spines 1–4 cm. long: leaves 2 m. and more long, usually continuously pinnate but sometimes interrupted, pinnae on main part of rachis 2–5 cm. apart; petiole slender, 1 m. or more long, lower part carrying prominent spines some of which may be 10–15 cm. long, upper part unarmed; pinnae sometimes 1 m. long and about 3 cm. broad, gray-green and conspicuously cross-veined between the prominent side-ribs, midrib upstanding, glabrous on both

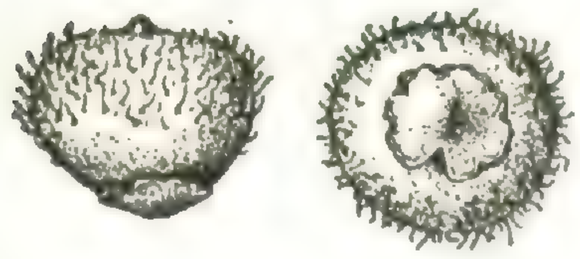

Fig. 50
Bactris barronis

surfaces, glossy above, setulose on margins of upper part, apex oblique: cymba or spathe 15–30 cm. long, densely black-spiny; spadix dense, the fertile part short and 10–15 cm. long: fruit broad-turbinate or short-pyriform, truncate at apex, about 1 cm. thick and a little longer, often angled by pressure, dark green for a long time but eventually orange-red, the upper part covered with short bristly hairs but which are caducous or may soon weather away; cupule small, nearly or quite flat, equal in the two series, shallowly lobed.

Panama.

CANAL ZONE: woods, Barro Colorado Island, *Bailey 503, 535;* Canal Zone Forest Preserve, *Allen 2538.* PANAMÁ: Río La Maestra, *Allen 9.*

8. BACTRIS COLORADONIS Bailey, Gent. Herb. 3:104. 1933.

Bactris coloradensis Burret, in Fedde's Rep. Sp. Nov. 34:217. 1933.

Tall, slender, 8 m. or more, not soboliferous or definitely colonized; trunk 4 cm. thick, lacking definite rings, armed with scattered brownish-black spines 1–5 cm. long: leaves 3 m. long, irregularly pinnate, some of the pinnae clustered and others widely spaced; petiole 1 m. or more long, deeply channelled on upper face, pubescent, beset throughout its length with slender spreading brown-black spines 1–5 cm. long; pinnae 25 or more pairs, to 1 m. long, 3–5 cm. broad, glabrous, dull in color, midrib very prominent and side-ribs strong so that the pinna has a ridged look, rather strongly cross-veined, margins usually setulose on upper part, apex a very slender tail-like extension: cymba or spathe 25 cm. long, densely brown-acicular, usually falling before fruit matures: fruit in a close short cluster, globular to obovoid or short-pyriform, 2–2.5 cm. long and 1.5 cm. thick, obtuse and beakless at apex, glabrous, attractive deep orange; nutlet about 12–15 mm. across and a little less in height; cupule shallow and small, with lightly crenate margins.

Fig. 51. *Bactris coloradonis*

Panama.

CANAL ZONE: dry woods, Barro Colorado Island, *Bailey 502, 653.*

9. BACTRIS ORARIA Bailey, Gent. Herb. 6:232. 1943.

Stems cane-like, usually about 4 m. but sometimes 6 m. tall, 2–3 cm. thick, not always erect but often twisting or almost scandent or procumbent on surrounding vegetation, foliage with a light grayish aspect, in colonies of many canes: leaves pinnate, nearly or quite 1 m. long, 5 or 6 in number and tufted at top of cane; petioles about 20 cm. long, flattened on upper surface and convex on lower surface, with sparse gray black-pointed spines 5–9 mm. long and a few flattened ones 2.5–6 cm. long; leaf-sheaths long, more or less imbricate, persistent, covering much of the cane, short-spiny, upper margins held together by fibrous network; pinnae 65–75, mostly opposite but often with open intervals between them, small, 25–30 cm. long, 2.5–3 cm. broad, the upper ones sometimes only 10–12 cm. long and 9–12 mm. broad, acuminate to sharp points, glabrous, midrib marked but the

many lateral veins hardly noticeable, margins scabrid; rachis bearing spines 2–8 cm. long: cymbas firm, interfoliar, persistent, expanded or protruding part of inner or main cymba 14–16 cm. long, 6.5–7.5 cm. wide, acuminate to slender point, bearing many short gray spines some of which may weather away; rachillae when dry; cupule very small, strongly lobed, striate, scarcely applied to base of dru 6–9 cm. long, terete, slender, glabrous: fruit oblate and somewhat irregular in circumference, 20–22 mm. across the long way, about 15–17 mm. high, very little tapered to base, top flat and beak very small, yellow, glabrous, strongly wrinkled when dry; cupule very small, strongly lobed, striate, scarcely applied to base of drupe.

Panama.

CANAL ZONE: vicinity of Farfan Beach, *Allen 2580.* PANAMÁ: beaches just back of the sea sands, Nueva Gorgona, *Allen 2551;* Tabeguilla Island, Panama Bay, *Allen 2543* (TYPE); Trapiche Island off coast of Pedro Gonzales, Perlas Islands, *Allen 2614.* COCLÉ: Aguadulce, along outskirts of the tidal belt, *Pittier 4975.*

10. BACTRIS SUPERIOR Bailey, Gent. Herb. 3:99. 1933.

Pyrenoglyphis superior (Bailey) Burret, in Fedde's Rep. Sp. Nov. 34:246. 1933.

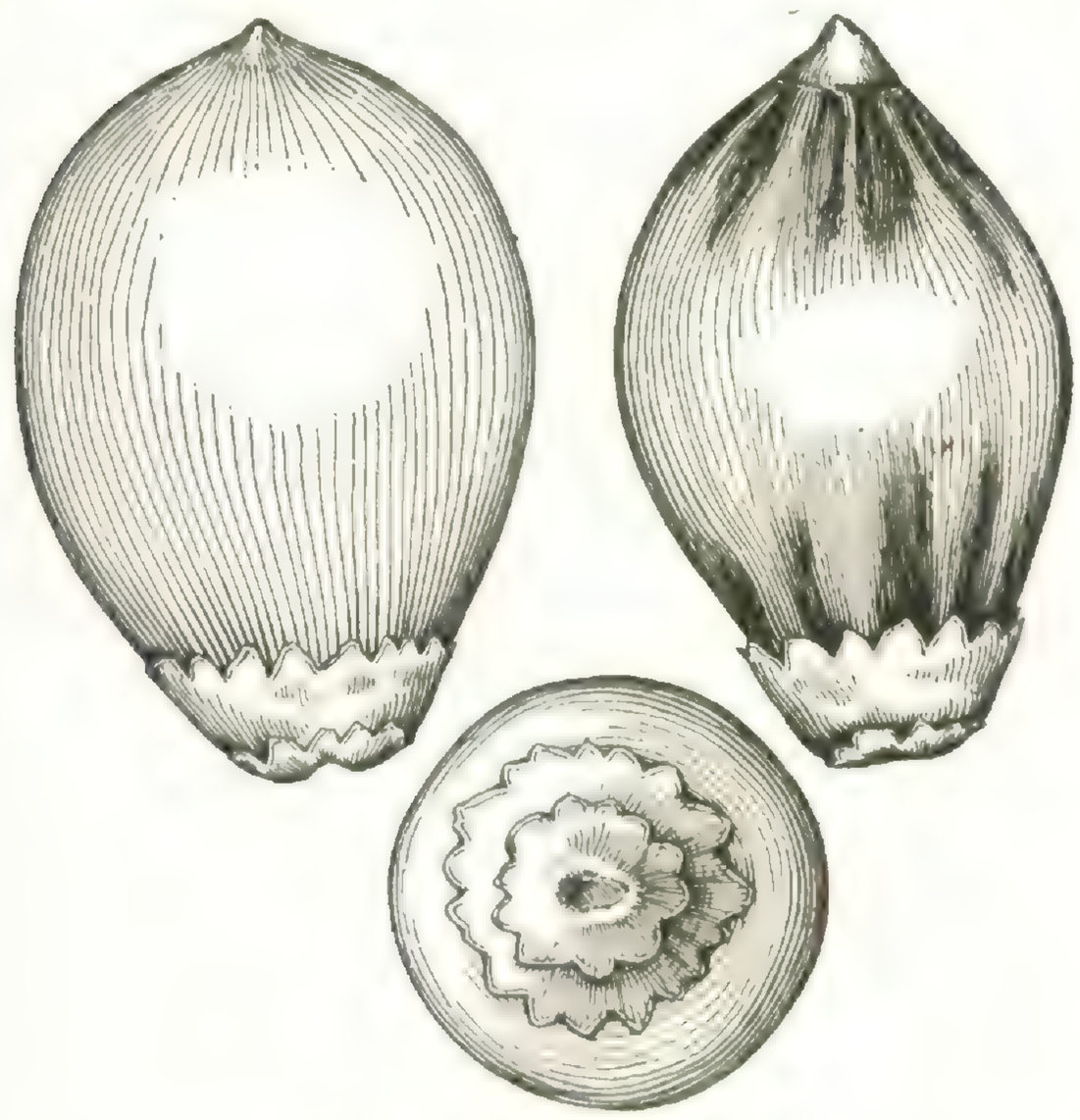

Fig. 52. *Bactris superior*

Tree 5–10 m. tall or in dense woods to 15 m. or more, in open colonies or sometimes as single plants but not extensively soboliferous, trunk 3–5 cm. thick bearing rings of blackish spines 4–5 cm. long and blank spaces between the successive rings: leaves 2 m. or more long, evenly pinnate, petiole bearing spines 2.5 cm. long and a few longer ones interspersed; pinnae 30–40 pairs attached 2–5 cm. apart, 40–75 cm. long, 3–4 cm. broad at middle, dull green and somewhat lighter-colored underneath, glabrous on upper surface and very closely puberulent on under surface, margins setulose, midrib prominent and side-ribs well marked, apex oblique: spathe or cymba 30-40 cm. long, pubescent or scariose on surface, covered with black short weak spines: fruit oblong-turbinate to somewhat obovoid when fresh but conic-pointed when dry, 3.5–5 cm. long, purplish at full maturity, glabrous, cupule prominent.

Panama.

CANAL ZONE: woods on Barro Colorado Island, *Bailey 162.* PANAMÁ: Río La Maestra, *Allen 42.*

11. BACTRIS BALANOIDEA (Oerst.) Wendl. in Kerchove, Les Palmiers, 233. 1878.

Augustinea balanoidea Oerst. in Kjoeb. Vidensk. Meddel. 1858:39. 1859.
Pyrenoglyphis balanoidea Karst. Fl. Columb. 2:142. 1866.

Slender, in large thickets but not densely soboliferous, very spiny but old trunks becoming almost bare: leaves 1–2 m. long, evenly pinnate; petiole very slender, 50–75 cm. long, about 1 cm. thick, rusty-pubescent, the dark brown spines 2–7 cm. long, the rachis well armed and pubescent; pinnae 30–40 pairs, 2–5 cm. apart at points of attachment, 30–50 cm. long, 1–2 cm. broad, grayish-green, puberulent on under surface, margins spiculose, midrib prominent and thinner veins either side: spathe or cymba 15–65 cm. long, thickly covered with blackish prickles; spadix bearing about a dozen simple short branches, pistillate flowers mostly about midway of the branches or rachillae: fruit cream-colored, probably becoming purple, oblong-ovoid, about 4 cm. long, sides nearly parallel, blunt at apex; nutlet enveloped in thin hair-like fiber, black, pores not of equal height on the surface.

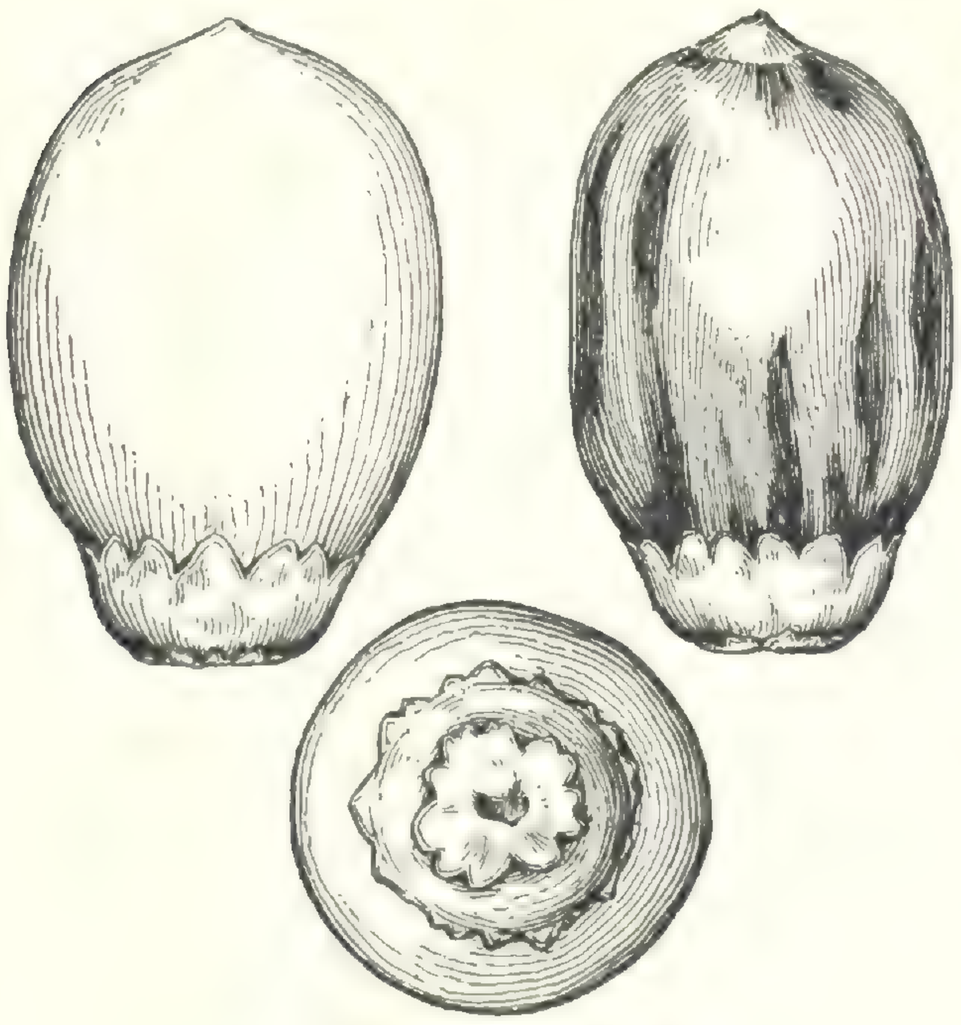

Fig. 53. *Bactris balanoidea*

Wet or swampy places, near Fort Sherman, Bay of Limón and apparently on Barro Colorado Island.

CANAL ZONE: Fort Sherman, Bay of Limón, *Bailey 218*.

It is not yet certain whether the Panama plant is the same as the *balanoidea* of Oersted, who got his palm at Puntarenas on the Pacific side of Costa Rica. Guatemalan material has also been referred here. Oersted did not have or describe the leaves of his plant; good recent collections at Puntarenas are required to determine the identities.

12. BACTRIS AUGUSTINEA Bailey, Gent. Herb. 3:95. 1933. (excl. syn.)

Heavily spined, growing in dense clumps 3 m. tall; trunk 5–7 cm. thick, the conspicuous leaf-sheaths held together by encircling fibrous strands: leaves 1–2 m. long, regularly many-pinnate, petiole provided with dark brown angled spines 3–8 cm. long on sheath and shorter on rachis; pinnae 25 or more pairs, contiguous and evenly spaced, 30–45 cm. long and 2.5 cm. or less broad, grayish-green and nearly glabrous, margins spiculose,

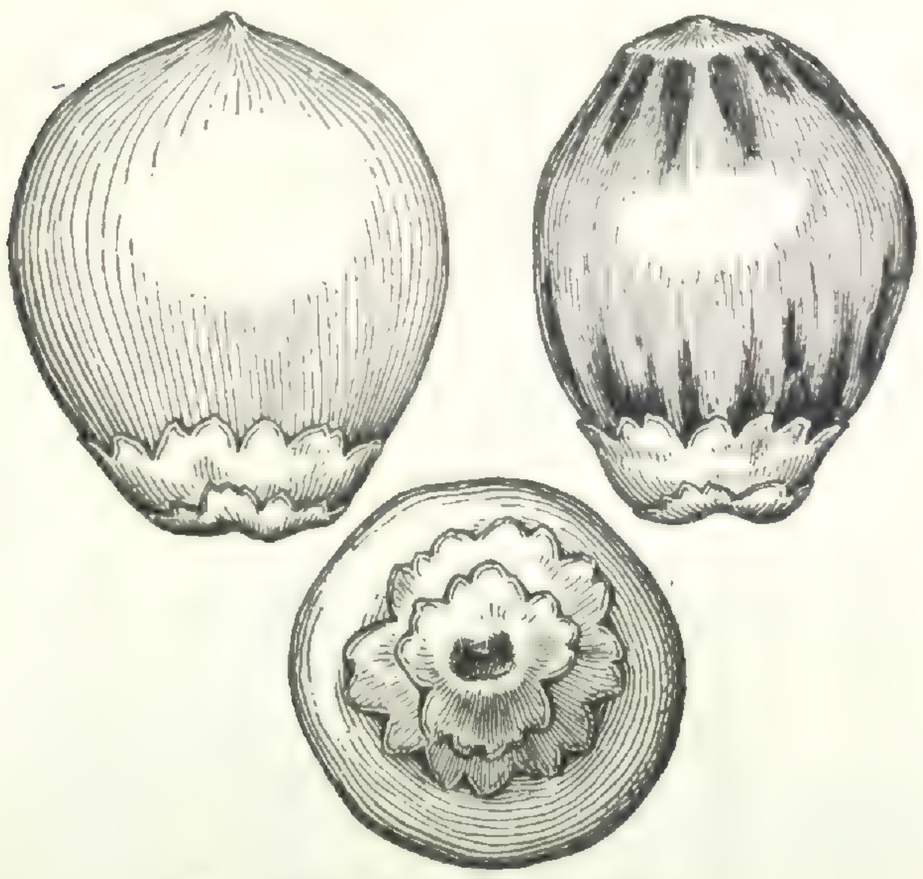

Fig. 54. *Bactris Augustinea*

midrib and side-ribs conspicuous: spathe or cymba about 25–30 cm. long, many-ribbed, pubescent and thickly aciculate; spadix with 10 or fewer branches near apex of peduncle, each 12–20 cm. long: fruit at first whitish, becoming dull purple, globular-oblong or indistinctly obovoid but becoming more or less conic when dry, 3–4 cm. long, glabrous, the scalloped cupule prominent; nutlet 2–2.5 cm. long, imbedded (when dry) in a mealy but firm mesocarp.

CANAL ZONE: in low ground near Summit, *Bailey 437*.

13. BACTRIS MAJOR Jacq. Select. Stirp. Amer. Hist. 1:280. 1763.
Pyrenoglyphis major Karst. Fl. Columb. 2:141. 1866.

Strong upright palm producing many stout canes 6–8 m. tall and 5 cm. thick that become free of thorns and are then white-ringed, very spiny on sheaths: leaves large, 2–2.5 m. long, dull green; pinnae 30 or more pairs, glabrous except finely setose on margins, 2–3 cm. or less broad, long-acuminate, 40–65 cm. long, midrib stout and lateral veins conspicuous: spadix 30–40 cm. long, the prominent compressed peduncle setose-spiny toward the top and soon downward-curved or goose-necked; cymba bearing scattered stiff hairs but practically glabrous on the surface, flower-cluster branching nearly or quite from its base and lacking a continuing rachis; pistillate flowers scattered along the rachillae and about 4 mm. across at anthesis, the corolla-cup hairy on its upper part, staminodes represented by an apron or membranous ring on inside of the cup: fruit ellipsoidal or elliptic-ovoid, 4–5 cm. long and 3.5–4 cm. thick, purplish when mature, becoming pointed or peaked when dry; cupule doubly crenate.

Apparently in Panama, along streams and arroyas; Colombia. The following determinations are not yet positive:

PANAMÁ: Río La Maestra, *Allen 42; Pittier 6756*. DARIÉN: *Pittier 6620*.

9. ASTROCARYUM G. Meyer

ASTROCARYUM G. Meyer, Prim. Fl. Esseq. 265. 1818.

Heavily armed monoecious pinnate-leaved palms, usually with tall erect single trunk but sometimes soboliferous and infrequently the caudex not developing into a bole (plant more or less acaulescent): leaves usually long, conspicuously ascending and overarching, irregularly and unequally pinnate, the pinnae frequently aggregate or clustered on the rachis: spadices interfoliar but lowest leaves sometimes falling before the fruits mature, consisting of a stout spiniferous peduncle that extends as an axis or rachis from the sides of which many usually simple short branches or rachillae extend, spadix at first inclosed in a long scarcely woody armed cymba-like spathe of 2 valves but which after anthesis is likely to hang as a dead member on a long peduncle and much longer than broad: flowers borne usually on the rachillae, the few pistillates at base and the numerous staminates compactly occupying the upper part, but sometimes the main rachis also bearing pistillate flowers on its upper part; staminate flowers 4–10 mm. long at anthesis,

with small calyx and much longer more or less tubular or gamopetalous corolla with valvate lobes, 6 exserted stamens with long versatile or erect anthers, minute pistillode sometimes present; pistillate flowers much larger, 12 or more mm. long, conic, envelopes usually connate; ovary 3-loculed: fruit a drupe-like body but mesocarp soon becoming dry or disappearing or remaining in fibrous elements, 3–8 cm. long, ovoid, obovoid or subglobose, variously beaked, smooth, asperulate or aculeate, 1- to 2-seeded, retaining the accrescent floral cup; nutlet with 3 often ornamented or radiate pores, albumen homogeneous, very hard, cavitous in center, raphe much branched.

Species about 50, island of Trinidad, Costa Rica, South America, largely in Brazil.

a. Fruit unarmed: trunk very spiny: pinnae attached by narrow bases, not multiple: spines on leaf-rachis not winged ..... 1. A. STANDLEYANUM
aa. Fruit aculeate: armature of trunk on bases of old leaves that carry the spines with them when they weather away: pinnae with very broad bases, multiple by division: spines on concave under surface of leaf-rachis very broad and thin-edged or alate ..... 2. A. ALATUM

1. ASTROCARYUM STANDLEYANUM Bailey, Gent. Herb. 3:88. 1933.

Erect stout tree, 12–15 m. tall.; trunk to 20 cm. diameter, wood hard, armed with deflexed flattened spines 10–15 cm. long: leaves 2–4 m. long, glossy on upper surface, clustered into a close broad crown; pinnae numerous, irregularly placed on the rachis and often clustered, 1 m. long, 2–4 cm. broad, being long and narrow with parallel sides, glabrous or becoming so when a loose scurf falls, ridged with midrib on upper surface and showing more or less prominent lateral nerves, margins bearing small spicules; petiole 1 m. or more long, armed with retrorse flat prickles from 2 to 15 cm. long: spadix 50–60 cm. long at anthesis aside from the long terete armed peduncle, spathe black-spiny and soon becoming free and hanging or falling, rachillae 10–15 cm. long, in whorls or irregularly placed and at the base of which are 2 or 3 pistillate flowers 15–18 mm. long in the crooks of the branchlet; staminate flowers with long exserted versatile anthers 5–7 mm. long, closely set on extended part of branchlet, cream-colored: fruit globular-oblong-obovoid, 4–4.5 cm. long including the prominent beak, about 3 cm. thick, 1-seeded, orange, roughish-papillate, unarmed; nutlet about 2 cm. long, with longitudinal black stripes, pores with radiating lines.

Fig. 55
Astrocaryum Standleyanum

Conspicuous forest tree in central Canal Zone and probably widely distributed.

CANAL ZONE: Barro Colorado Island, *Bailey 211;* Forest Preserve, *Allen 2537,* a form with fruits less than 4 cm. long and less than 3 cm. thick, leaf-margins only minutely setulose or practically nude.

2. Astrocaryum alatum Loomis, in Jour. Washington Acad. Sci. 29:142. 1939.

Tree 4–6 m. tall, 12–15 cm. diameter, the trunk without spines but the persistent bases of old leaves bearing spines and carrying the spines with them when eventually they wither away: leaves 6–7 m. long, widely spreading on long petioles and more or less arched, the petiole occupying one-third the length of leaf just stated; pinnae usually in closely placed clusters of 2–15 parts or segments,

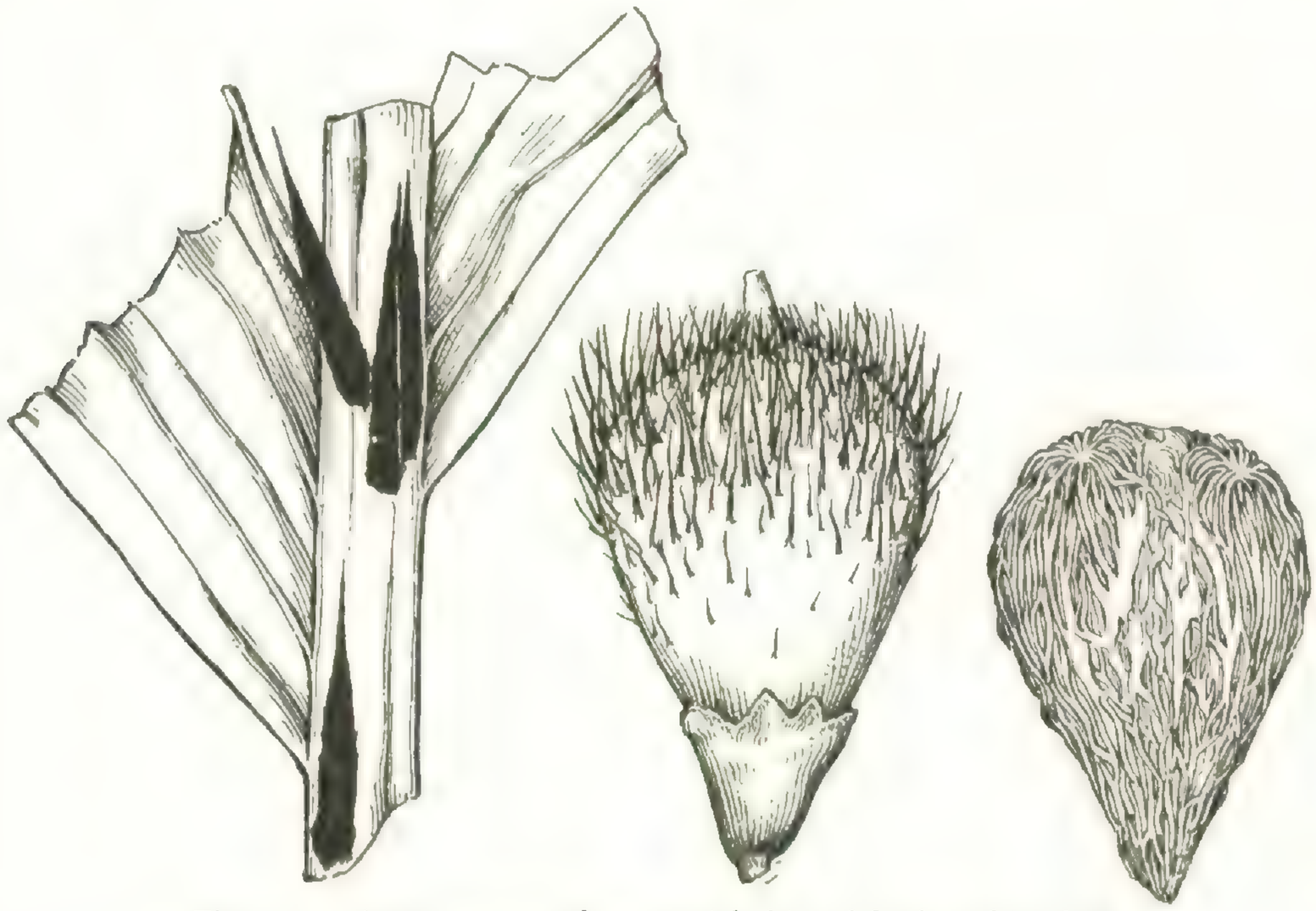

Fig. 56. *Astrocaryum alatum* with bit of leaf rachis, fruit, nut.

the terminal segments confluent, basal pinnae 50–60 cm. long, middle pinnae 15–95 cm. long, width 3–6 or 7 cm., apices truncate or oblique and erose, upper surface glossy, under surface gray, strong nerves several to many and prominent, surfaces free of spines, under side of leaf-rachis at middle and base bearing appressed flat thin-winged spines 2–5 cm. long and 4–8 mm. broad: spadices erect or strongly ascending, as broad as long, flowering part 20–25 cm. long, the simple rachillae 16–18 cm. long; staminate flowers urceolate, 5–6 mm. long, the short basifixed anthers barely exserted: fruit obpyriform, 6–7 cm. long, 4 cm. broad near apex, angled on the lower part from pressure in the congested short spike, conic beak 7–10 mm. long, narrow base set in a deep floral cup, brownish-green becoming rusty, upper part pimpled and bearing brown-black hairs 12 mm. or less long, beak unarmed; when dry the thin shell breaks easily and discloses an angled nutlet 5–7 cm. long with 3 conspicuous radiated pores and surface marked with rapheal fibers.

Panama, Costa Rica. The species was founded on collections in the forest at Río Hondo, Plains of Santa Clara, Costa Rica, alt. 100 m., but known in that country in other places. Known as *Coquillo*.

Canal Zone: Quebrada Lopez, *Allen 2111*. Coclé: region north of El Valle de Antón, 800–1000 m., *Allen 2535, 2720*.

10. AIPHANES Willd.

AIPHANES Willd. in Mém. Acad. Sci. Berlin, 1804:32.
Marara Karst. in Linnaea 28:389. 1856.

Small or medium-sized very spiniferous monoecious irregularly pinnate-leaved trees with solitary or soboliferous armed trunks, spadices interfoliaceous: leaves pinnate and pinnatisect, spine-bearing on the long sheaths and petiole as well as usually on rachis and sometimes on under side of pinnae themselves, the pinnae usually broadest toward apex and cuneate at base, erose or dentate or jagged at the truncate or expanded summit, alternate or clustered on the rachis: spadix long and slender-branched, at first erect but becoming horizontal or pendent, attended by narrow more or less spiny spathe-valves that do not permanently inclose it and are not cymba-like: flowers small and numerous; staminates mostly on upper part of rachillae and pistillates on lower part but typically 1 pistillate between 2 staminates, sometimes an entire spadix mostly pistillate; sepals and petals 3 each, petals usually valvate in both sexes; stamens 6, in one group (Macroanthera) linear and flower-bud longer than broad, in the other group (Brachyanthera) very short and suborbicular and flower-bud as broad as long; ovary 3-loculed; staminodia in some species represented by a toothed cup: fruit a colored 1-seeded little drupe with either fleshy or firm mesocarp, globose or subglobose, usually 1–2 cm. thick, 1-seeded; nutlet or seed globular, rugose or pitted, albumen continuous and solid.

About 30 species, West Indies and South America, now first recorded in Panama. The recognized species until recently have been named in *Martinezia*, but that genus is a confused concept and does not apply to these plants. The generic name may be pronounced as if spelled *A-if'-an-ees*.

1. AIPHANES FUSCOPUBENS Bailey, Gent. Herb. 6:209. 1943.

Tree 5 m. tall, apparently not soboliferous, trunk covered with spines: leaves 2 m. long, more or less glossy; petiole short, bearing blackish plano-convex spines of different lengths some of which are 8 cm. long, and also shreds at the somewhat expanded base, the surface as well as that of the rachis showing much black hairy pubescence 1–3 mm. long; pinnae 20 or more either side the ridged rachis, 15–30 cm. long, 10 cm. broad at apex or some of them split into 2 or 3 narrower units, apex irregularly truncate and shallowly erose and toothed and sometimes the upper margin produced into a short sharp finger, sides straight and entire, many-nerved and lacking definite midrib, glabrous, surfaces bearing no spines: inflorescence erect; peduncle slender, 5–7 mm. thick, 1 m. and more long, armed with sharp prickles 15 mm. or less long, lower half inside narrow sparingly weak-prickly spathe-valves, upper or flowering free part 40–50 cm. long, axis angled and dark-pubescent, the simple slender branches or rachillae 30–40 cm. long and strongly ascending; flowers close together along the rachillae, the lower or pistillate ones lightly sunken in shallow cavities, the upper smaller staminate ones superficial; pistillate flowers about 4 mm. thick and 5–6 mm. long; staminate flowers in full bud about 3 mm. either way: fruit not seen.

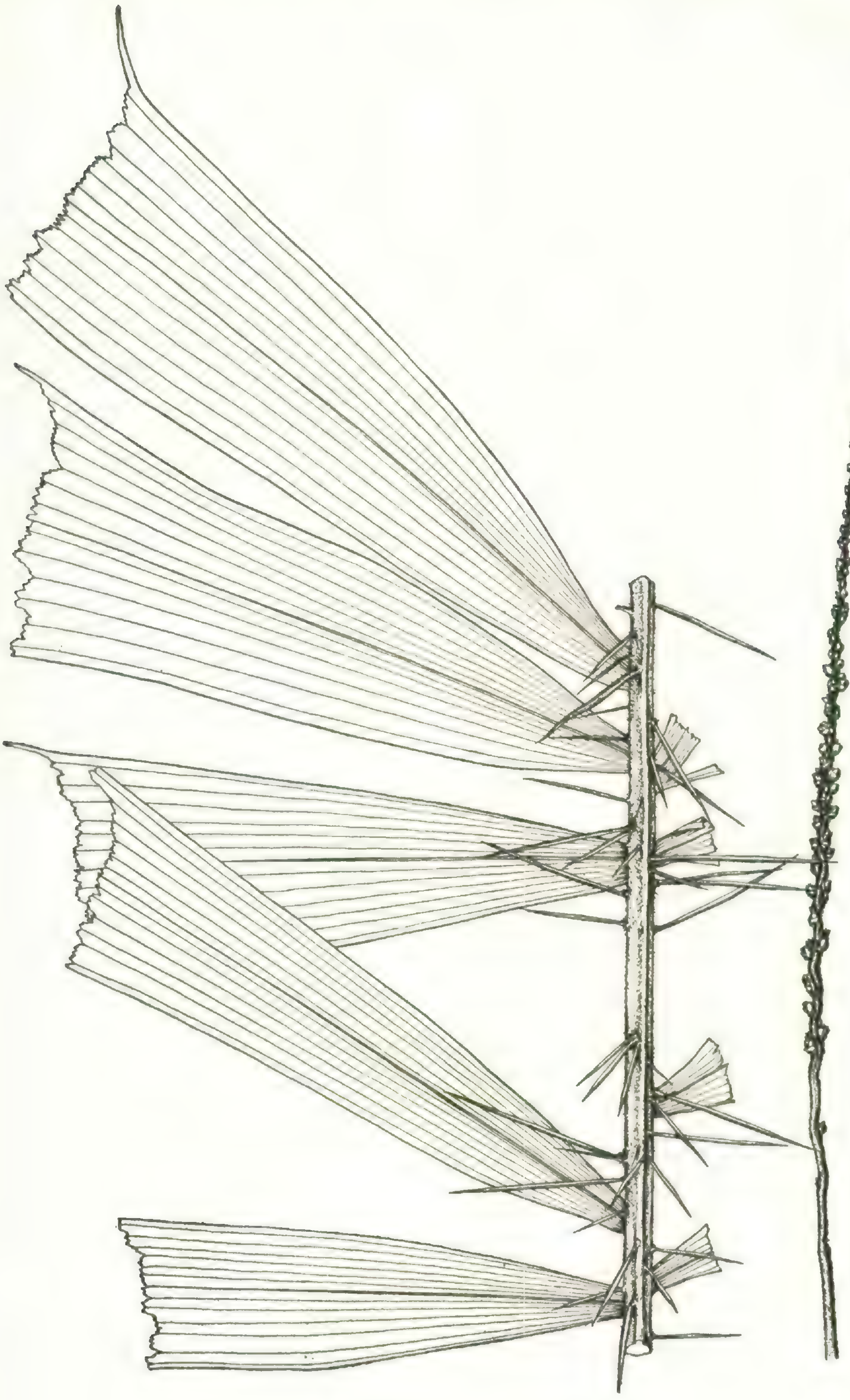

Fig. 57. *Aiphanes fuscopubens*

PANAMÁ: cloud forest, on hills above Campana, 600–800 m., *Allen 1870.*

Readily distinguished by the dark or fuscous pubescence of flowering branches as well as less markedly of peduncle and leaf-rachis.

11. CHAMAEDOREA Willd. "Dorea Palms"

CHAMAEDOREA Willd. Sp. Pl. 4:638, 800. 1806. *Nomen conservandum.*
Nunnezharia Ruiz & Pav. Fl. Peruv. & Chil. Prodr. 147. 1794. *Nomen rejiciendum.*
Nunnezia Willd. Sp. Pl. 4:1154. 1806.
Stachyophorbe Liebm. in Oevers. Dansk Vid. Selsk. 1845:8. 1846.
Collinia Liebm. ex Mart. Hist. Nat. Palm. 3:308. 1849.
Stephanostachys Klotzsch ex Oerst. in Kjoeb. Vidensk. Meddel. 1858:26. 1859.
Spathoscaphe Oerst. op. cit. 29. 1859.
Eleutheropetalum Wendl. ex Oerst. op. cit. 6. 1859.
Dasystachys Oerst. op. cit. 25. 1859.
Kinetostigma Dammer, in Notizbl. Bot. Gart. u. Mus. Berlin 4:171. 1905.

Small dioecious unarmed palms, mostly arundinaceous with slender ringed or jointed canes or trunks: leaves pinnate, pinnatisect or pinnately veined, minute flowers of differing morphology not distinctly sunken in the rachis or only apparently so when crowded, the peduncles bearing few or several sheathing bracts or spathes that may fall or become shredded before fruiting and leave scars or rings that are marks of the genus: spadices inter- or infrafoliar: perianth-parts in two series of 3 each but variously connate and sometimes each series united into one body; stamens 6, often connate: fruit small, hard or thinly succulent only on the exterior, ellipsoid, oblong, somewhat pyriform, stigma basal, seed single, albumen plane (not ruminate).

About 100 species, from Mexico to Peru and Brazil, not in the West Indies, a few of them grown in conservatories for ornament and sometimes planted in warm countries. They are mostly woods palms, favoring moist or shaded conditions.

Chamaedorea is a troublesome genus to the taxonomist because the species are so many, numbers of them local, marks between them often technical and close, both sexes not likely to be represented in collections, and the original descriptions often so brief or inadequate as not to be identifiable. The species may be confused with the Geonomas, but the two genera are distinct and are readily distinguished by the multiple spathes or bracts on the peduncle of *Chamaedorea,* by absence of scars on the same rachilla representing two sexes, and lack of sunken pits where flowers and fruits are borne, the scars or placements being single and simple rather than two or three together. The Dorea Palms abound in sigmoid pinnae or lobes, curving in opposite directions like the long or old-fashioned letter S or the Greek letter Σ, the two sides not being the same and the veins strongly incurved at base. In some cases the pinnae are falcate rather than sigmoid, the two sides not greatly unlike and not bulging or gibbous, and ribs little if at all incurving at base.

a. Leaf simple (of one piece), bilobed at apex.
  b. Margins of leaf entire or not serrate ..... 1. C. TERRYORUM
  bb. Margins deeply serrate ..... 2. C. COCLENSIS
aa. Leaf pinnate, with several or many pinnae.

b. Rachillae of pistillate spadix very short, not more than 4 cm. long, and the upper ones much shorter ..... 3. C. BRACHYCLADA
bb. Rachillae much longer.
c. Leaf-segments or pinnae not sigmoid or falcate or with curved and unequal sides, tapering straightway to apex.
d. Pinnae above 50 cm. long, 3–5 cm. broad ..... 4. C. WOODSONIANA
dd. Pinnae 25 cm. or less long, 2 cm. or less broad ..... 5. C. SEIBERTII
cc. Leaf-segments or pinnae not straight but with bulging or unequal sides, more or less sigmoid or falcate, mostly curved at the end, broadest at about the middle, veins usually curving to narrowed base.
d. Pistillate spadix a simple much-congested spike: pinnae about 9 pairs, equally spaced ..... 6. C. ALLENII
dd. Pistillate spadix branched (of 2 or more rachillae).
e. Plant acaulescent and very small, usually not exceeding 1 m. tall over all and commonly much less: pinnae small, 7–9 or more pairs.
f. Pinnae 17 cm. or less long and one-third as broad: staminate spadix or cluster branched from near top of peduncle and therefore lacking a continuing rachis ..... 7. C. MICROPHYLLA
ff. Pinnae of similar length as in f but only one-fifth as broad as long: staminate spadix with a continuing rachis and the rachillae therefore lateral ..... 8. C. PYGMAEA
ee. Plant caulescent, the trunk or cane itself usually 1 m. or more tall: leaves various, pinnae 20 cm. or more long.
f. Pinnae prominently broad, 6–13 cm. wide, markedly sigmoid.
g. Apex of pinnae produced into slender tail-like points: pinnae about one-third as broad as long ..... 9. C. LUCIDIFRONS
gg. Apex of pinnae acuminate, not caudate: widest pinnae nearly or quite one-half as broad as long.
h. Main nerves of pinnae many and prominent, usually a dozen or more: pinnae thin, brittle and papery ..... 10. C. LATIPINNA
hh. Main nerves of pinnae fewer, usually not more than 6, and not outstanding: pinnae of good substance: fruit black ..... 11. C. FLAVOVIRENS
ff. Pinnae prominently narrow or at least not very broad, one-fourth or less as broad as long.
g. Length of pinnae 30 cm. or less, the nerves or ribs not very pronounced.
h. Petiole slender, usually 10 cm. or more long, not suddenly expanded at base.
i. Shape of pinnae much broader than linear and noticeably sigmoid.
j. Rachis of leaf-blade without long vacancies on one side or the other due to absence of pinnae (which are more or less paired even though opposite).
k. Apex of pinnae narrowing to very slender curved long point or cauda: fruit yellow ..... 12. C. PACAYA
kk. Apex of pinnae narrow but not curved ..... 13. C. HAGENIORUM
jj. Rachis with long nude space on one side or the other due to absence of two or three pinnae; apex acuminate but upwardly curved ..... 14. C. WEDELIANA
ii. Shape of pinnae long-linear, not more than one-fifth as broad as long, only indifferently sigmoid ..... 15. C. LINEARIA
hh. Petiole very short and stout, only 3–4 cm. long, concave on upper face, with quickly expanded striate base ..... 16. C. PITTIERI
gg. Length of pinnae 50 cm. and more, the nerves or ribs conspicuously parallel and prominent.
h. Width and length of pinnae uniform or nearly so along the rachis.

i. Upper half of pinnae strongly falcate, usually caudate ..... 17. C. WENDLANDIANA
ii. Upper half of pinnae not markedly curved or falcate ..... 18. C. SCHERYI
hh. Width, and sometimes the length, of pinnae very uneven or irregular on the same blade ..... 19. C. FALCARIA

1. CHAMAEDOREA TERRYORUM Standl. in Field Mus. Bot. Ser. 22:326. 1940.

Small, practically acaulescent, the brief caudex being covered by leaf-bases, 30–40 cm. tall but perhaps reaching 75 cm.: leaf-blade 20–30 cm. long and 9–15 cm. broad, glabrous, simple, cuneate-obovate, deeply bilobed at apex with the lobes acuminate, main veins many and prominent, 5–10 mm. apart, intermediate veins many and obscure, rachis 12–16 cm. long and blade long-narrowed to base; petiole 11–25 cm. long, slender, striate: spadices radical, long-peduncled but shorter than the leaves and conspicuously sheathed; staminate spadix with a continuing straight rachis and 16 or more diverging very slender rachillae 3–6 cm. long and loosely flowered; pistillate spadix and fruit not described.

Panama.

DARIÉN: on Cana-Cuasi trail, Chepigana District, *Terry & Terry 1452*.

2. CHAMAEDOREA COCLENSIS Bailey, Gent. Herb. 6:236. 1943.

Slender, 1.5 m. tall, the sheathed stem or culm 1 cm. or less thick, rings or nodes 4–5 cm. apart: leaves very few, simple and deeply 2-lobed at apex, blade 30–40 cm. long and 20 cm. wide, broadly obovate in outline, cuneate to base, outer margins on upper half conspicuously serrate or serrate-dentate, glabrous, glossy at least underneath, rachis prominent as a midrib particularly underneath, main lateral ribs about 25 on each side and 5 mm. apart and ending in sinuses of the serratures, prominent on upper face: staminate spadices few from separate nodes beneath the leaves, ascending, peduncle 10–12 cm. long and the bracts soon shedding; rachillae 6 or 7 from near apex of peduncle, 12–15 cm. long, closely ascending, glabrous, strongly angled in drying, rather closely flowered; staminate flower-buds just preceding anthesis about 1 cm. across, obtuse or somewhat flattened, calyx a connate cup without evident lobes, petals valvate; pistillate sex unknown: fruit oblong, blunt, 12–13 mm. long and 9–10 mm. broad, smooth and glossy, the thin skin soon shattering.

Panama.

COCLÉ: vicinity of El Valle de Antón, alt. 600 m., *Allen 1815*.

3. CHAMAEDOREA BRACHYCLADA Wendl. in Gartenfl. 29:101. 1880.

Trunk very short, 2–3 cm. thick, closely ringed: leaves about 3, erect, pinnate, somewhat more than 1 m. long, sheath short and tubular; petiole 40–50 cm. long; pinnae or segments 20–25 on either side the rachis, linear-lanceolate, acuminate, the lower margin decurrent, the large ones 30 cm. long and 2–2.5 cm. broad, with 5 nerves and those on lower surface rough: pistillate spadix infrafoliar, long-peduncled and spreading with 7 tubular spathes; rachis about 10 cm. long, much branched, the branches or rachillae 60–70, filiform and flexuose, much spreading, 4- to 7-flowered, the large flowers yellow-green, calyx very short, petals erect and

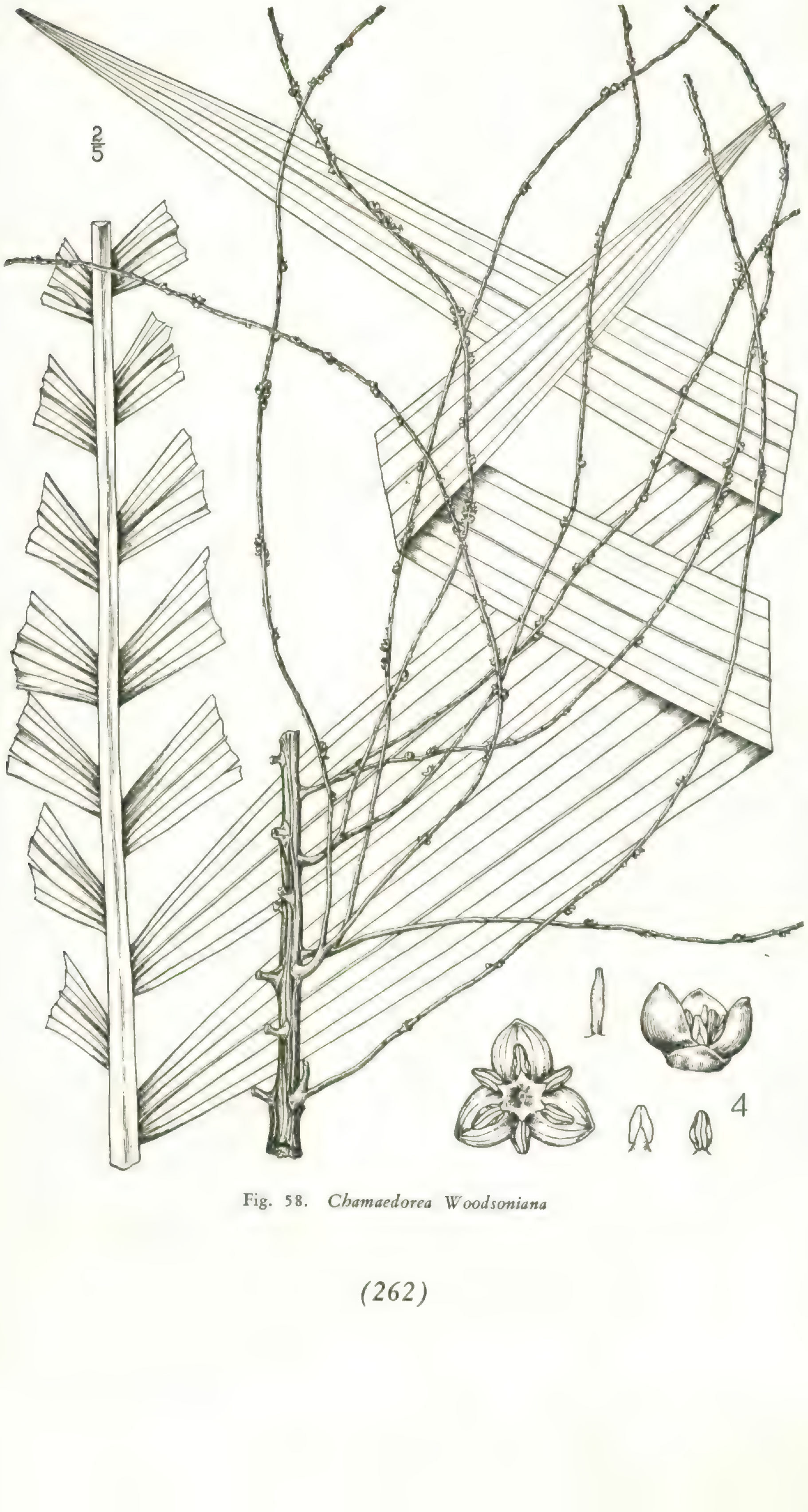

Fig. 58. *Chamaedorea Woodsoniana*

convolute-imbricate.

Grown in Europe from seeds sent from Chiriquí by Zahn; fruit and staminate spadix not described.

4. CHAMAEDOREA WOODSONIANA Bailey, Gent. Herb. 6:238. 1943.

Stout, 5–12 m. tall, slender: leaf-blade 1 m. long, with 20 or more pairs of opposite or subopposite long and large glabrous dark green pinnae; petiole 20 cm. and more long above the sheath, strongly ridged on top and more or less triangular in cross-section; sheaths 30 cm. and more long, stoutly many-striate, 3–4 cm. broad at middle, clasping the cane, narrowly winged at apex; main pinnae 60–65 cm. long, 3–5 cm. broad or the upper ones less than 2 cm., gradually and straightly tapering into long narrow ends or the young upper ones slightly curved but not sigmoid and caudate, all conspicuously ribbed particularly underneath, the central rib more pronounced than the 2 others on either side, intermediate nerves not prominent, the 5 main ribs 5–7 mm. apart; staminate spadix or truss large and diffuse in anthesis, 75 cm. and more long and very broad, on a many-sheathed peduncle 30–65 cm. long, sheaths soon shreddy; rachillae numerous, slender and flexuose, glabrous, simple or some of them once or twice forked, 20–50 cm. long, laxly flowered; pistillate spadix much like the staminate but rachillae fewer, shorter and less diffuse, 12–20 of them 10–30 cm. long: fruit globular, 8–10 mm. thick in mature dry state, somewhat fleshy on exterior, becoming wrinkled and reticulate in drying, cupule about 6–7 mm. across and with very broad lobes.

Panama; probably in Costa Rica.

COCLÉ: vicinity of El Valle de Antón, alt. about 600 m., *Allen 1901*. CHIRIQUÍ: in vicinity of Casita Alta, Volcán de Chiriquí, alt. 1500–2000 m., *Woodson, Allen & Seibert 948*.

5. CHAMAEDOREA SEIBERTII Bailey, Gent. Herb. 6:238. 1943.

Very slender, canes 1–2 cm. thick, ringed at intervals of 2–8 cm., plant 2 m. tall: leaf-blade 50–90 cm. long, bearing 16–24 alternate or subopposite pairs of very narrow glabrous many-nerved straight pinnae; petiole slender, angled, 12–14 cm. long above the tight closed finely striate sheath which is 18–20 cm. long; pinnae light green, thin, 20–25 cm. long and 1–2 cm. broad, tapering regularly to a long slender point which is often broken away, somewhat narrowed to base, standing 2–3 cm. apart on the very slender flattened rachis, with straight prominent midrib and several side-nerves close together: pistillate spadix composed of about 6 orange-colored branches or rachillae 6–12 cm. long issuing from a rachis only 4 or 5 cm. long, the slender reddish-orange peduncle 14–15 cm. long bearing 3 or 4 sheaths that soon become shreddy and fall at fruiting time and leave the ringed scars of their attachment: fruit globular, 7–8 mm. thick when dry and deeply wrinkled from the shrinking of the thin flesh, green or olive-green when fresh; cupule small, 4–5 mm. in expansion, deeply lobed.

Panama.

CHIRIQUÍ: valley of the upper Río Chiriquí Viejo, vicinity of Monte Lirio, 1300–1900 m., *Seibert 218;* vicinity of Callejón Seco, Volcán de Chiriquí, alt. 1700 m., *Woodson &*

Schery 502; slope of Cerro de la Horqueta, *Pittier 3189;* Sabana de El Salto, eastern slope of Volcán de Chiriquí, *Maxon 5272.*

6. Chamaedorea Allenii Bailey, Gent. Herb. 6:241. 1943.

Erect, 2 m. tall: leaves uniformly pinnate, blade 60–70 cm. long, glabrous, firm in texture, more or less glossy; petiole about 30–35 cm. long above narrow sheath, ridged and striate, 5–7 mm. broad; pinnae alternate or subopposite, about 9 pairs, equally spaced and not more than 3 or 4 cm. apart, terminal pair confluent, 25–30 cm. long, 3–6 cm. broad, narrow-lanceolate and not sigmoid, somewhat narrowed to base, acutely acuminate to caudate, prominently about 9-ribbed, main ribs 4–7 mm. apart, light-colored and pronounced on under surface, nearly confluent at base: spadix a single simple very dense spike about 8 cm. long at anthesis, on a peduncle 24 cm. long and which is completely contained in about 4 loose sheaths of which the uppermost is projected 3–4 cm. with an acuminate herbaceous end; pistillate flowers in 8 rows, bright yellow, so closely placed as to appear to be immersed in the rachis; calyx a shallow more or less undulate but not lobed cup in which loosely sit the 3 introrse petals inclosing the conic more or less 3-lobed ovary on which the 3 spreading or reflexed prominent stigmas are sessile; staminate spadix and fruit not seen.

Panama.

coclé: north rim of El Valle de Antón, *Allen 1909.*

7. Chamaedorea microphylla Wendl. in Bot. Zeit. 17:102. 1859.

Trunk simple, slender, erect, usually 1 m. or less tall, reported to 2 m., to 15 mm. thick, rings 4–7 cm. apart, surface white-spotted or punctate and somewhat glaucous: leaves 3–4, minutely punctate, about 45–50 cm. long, pinnate, the pinnae 7–9 pairs alternate or subopposite; sheath 7–9 cm. long; petiole about 10 cm. long, nearly terete but lightly grooved toward base; pinnae at the middle of rachis 14–17 cm. long and 3–4 cm. broad, oblong-lanceolate and sigmoid-curved, abruptly short-acuminate, contracted to base, midrib strong as well as 2 side-nerves, lowest pair of pinnae lanceolate and long- acuminate and somewhat reflexed, the upper pair confluent at base: spadix infrafoliar; staminate spadix once-branched or one or two of the rachillae forked near base, rachis 8–10 cm. long and not straightly continued through the cluster, the angled slender rachillae about 15, laxly flowered, 10–18 cm. long; pistillate spadix with rachis 6–7 cm. long and not continued, rachillae 7–12, simple or some of them forked near base, 4–8 cm. long, slender and flexuose.

Grown long ago under glass in Europe from seed collected by Warscewicz in Chiriquí, Panama; fruit not described. The Costa Rican plant that passes as this species is probably *C. pygmaea* Wendl.

8. Chamaedorea pygmaea Wendl. ex Dammer, in Allgem. Gartenzeit. 20:217, 249. 1852.

Stachyophorbe pygmaea Oerst. in Kjoeb. Vidensk. Meddel. 1858:10. 1859; l'Amer. Cent. 14: *t. IV, f. 1–16.* 1863.

Plant practically acaulescent, 60–80 cm. high over all, the caudex of 6–8 cm. being covered with bracts and leaf-bases and less than 2 cm. thick at surface of ground: leaves pinnate, 40–50 cm. long, of 10–12 pairs of opposite or subopposite glabrous thin pinnae that are 10–18 cm. long and 2 cm. or less broad, lower ones often shorter and narrower; pinnae gradually narrowed to acuminate apex and also narrowed to half the width at base, sigmoid-lanceolate, midvein prominent, 1 or 2 laterals on either side semi-prominent: spadices radical, the slender peduncle tubular-bracted or spathed, shorter than the foliage, laxly flowered; staminate spadix about 10 cm. long and 7 or 8 cm. broad, rachis continuous and emitting 20–30 spreading slender rachillae 4–5 cm. long; pistillate spadix simple or of very few branches 5–8 cm. long.

Chamaedorea pygmaea was based on plants from Colombia; the species occurs also in Costa Rica. It is variable in the width and size of pinnae as well as in the veining. It has been confused with *C. microphylla.*

DARIÉN: on Cana-Cuasi trail in Chepigana District, *Terry & Terry 1453.* CHIRIQUÍ: epiphytic in vicinity of Bajo Mona and Quebrado Chiquero, *Woodson & Schery 585,* rachis orange, fruit purple and globular, about 8 mm. diam.

9. CHAMAEDOREA LUCIDIFRONS Bailey, Gent. Herb. 6:244. 1943.

Slender, 2.5 m. tall: leaf-blade 40–50 cm. and more long, glossy and glabrous, with several very broad strongly ribbed alternate pinnae; rachis convex on the back, lightly ridged on upper face; pinnae 30–35 cm. long, 6–9 cm. broad, lance-oblong and strongly sigmoid, tapering to narrow point or to a cauda, with 7–15 conspicuous costa standing 4–10 mm. apart at the middle and prominently curved to the narrowed base, lucid particularly on the lower face: pistillate spadix once-branched from a short rachis, about 22 cm. long and nearly as broad, the glabrous rachillae 10–20 cm. long and divaricate or upwardly curved: fruit small, short-oblong, obtuse, 5–6 mm. long, 4–5 mm. thick, irregularly and shallowly wrinkled in drying; cupule small, the lobes spreading.

Panama.

COCLÉ: vicinity of El Valle de Antón, alt. about 600 m., *Allen 1814.*

10. CHAMAEDOREA LATIPINNA Bailey, Gent. Herb. 6:244. 1943.

Slender, 1 m. tall, with smooth glossy foliage: leaf-blades 30–50 cm. long, pinnate, apical part with 2 very broad confluent lobes, other pinnae alternate, few in number; rachis very thin and flattened, 2–3 mm. broad, ridged on top; pinnae thin, 25–30 cm. long, 10–13 cm. broad, strongly sigmoid, rather abruptly contracted to a short point, base very wide, conspicuous because of several or many curved strong ribs 1 cm. or more apart and less distinct ones between: spadices once-branched from a more or less continuing central axis; peduncle 25 and more cm. long, its length inclosed in striate sheaths; staminate spadix 25–30 cm. long and nearly as broad, the glabrous rachillae 18–25 cm. long and laxly flowered; staminate flowers with broad deeply lobed lightly imbricate calyx; pistillate spadix somewhat smaller, the fertile part about 20 cm. across in either direction: fruit

(immature) oblong and contracted to base, obtuse at apex, 10–12 mm. long, green in color.

Panama.

BOCAS DEL TORO: vicinity of Chiriquí Lagoon, *von Wedel 2275*.

11. CHAMAEDOREA FLAVOVIRENS Wendl. in Index Palm. 60. 1854.

Very slender, 2.5 m. tall with a more or less crooked trunk or cane about 1 cm. thick and rings 5–6 cm. apart, foliage yellowish-green: leaf-blade 30–35 cm. long, glabrous, somewhat lustrous, pinnate, rather thin and papery in texture; pinnae about 5 on either side, broadly oblong-acuminate, the terminal pair or bilobe much the broadest and the sinus more or less obtuse, others alternate, all sigmoid, short and rather abruptly contracted to an up-curved acumen, 15–20 cm. long, 4–6 cm. broad and the upper pair 8 cm., broader ones with 4–6 curved nerves and thinner ones between and not very arresting nor ridged even though prominent; petiole slender, about 20 cm. long above the conspicuously striate sheath, very narrowly channelled on upper face: pistillate spadix about 15 cm. long in fruit, of 5 or 6 ascending branches arising from near the top of the compressed about 5- or 6-bracted slender peduncle: fruit essentially globular or very short-oblong, black and glossy, somewhat fleshy, 1 cm. long when dry and mature and 8 or 9 cm. thick, obtuse, smooth but wrinkling in drying; cupule small and not prominent, outer series saucer-like, inner series lobed; seed contained in a striate case or shell, brown outside and inside, micropyle at base.

PANAMÁ: Cerro Campana, trail from Campana to Chica, alt. 600–800 m., *Allen 2644*.

This species is distinguished from *C. Pacaya* Oerst. by the much broader, more sigmoid, less pointed and more sparsely nerved pinnae; fruit black rather than yellow.

12. CHAMAEDOREA PACAYA Oerst. in Kjoeb. Vidensk. Meddel. 1858:12. 1859.
Chamaedorea Oerstedi Cook, in Nat. Hort. Mag. 18:168. 1939.

Slender, 2–3 m. tall, erect or somewhat flexuose, remotely ringed, trunk cane-like and about 15 mm. thick: leaves pinnate, 70–100 cm. long, glabrous; petiole sheath striate, about 12–13 cm. long; pinnae 5–7 pairs, alternate or subopposite, dull green and thin, more or less plicate, middle ones 15–20 cm. long, 3–4 cm. broad at middle and the terminal pair or lobes broader, tapering both ways and broadest at middle, sigmoid or broad S-shaped, the point long and very narrow or even caudate, one rib or midrib prominent and two or three thinner ones on either side, upper margin of terminal lobes sometimes serrate as if indicating the beginning of splitting: spadix with slender and compressed peduncle 30–50 cm. long, rachis 3–4 cm. long; rachillae 5–10, glabrous, 5–10 cm. long, ascending or spreading: fruit obliquely obovoid, about 10–12 mm. long, somewhat narrowed or one-sided to base, obtuse at apex, yellow at maturity, somewhat wrinkled in drying from shrinking of slightly fleshy mesocarp, stigmatic mark showing on flat side near base.

Panama; collected originally at Mt. Jaris, Costa Rica.

CHIRIQUÍ: Quebrada Chiquero, *Woodson & Schery 586;* Bajo Chorro, *Woodson & Schery 681, 702; Davidson 36;* Quebrada Velo, *Woodson & Schery 270.* CANAL ZONE: Quebrada Lopez, *Allen 2119.*

Since the vernacular name *Pacaya* is applied to several Chamaedoreas and also to other palms in Latin America, the binomial *C. Pacaya* also is often misapplied and misinterpreted, and care must be exercised in the identification of the particular species.

13. CHAMAEDOREA HAGENIORUM Bailey, Gent. Herb. 6:247. 1943.

Tree-like, to 1 m. or a little more tall, glabrous, foliage more or less glossy: leaves regularly pinnate, the blade 35–40 cm. long and 25 or more cm. broad; pinnae alternate, 5 or 6 on either side, narrowly oblong-lanceolate and gradually narrowed into straight tips, 15–20 cm. long, 2–3 cm. broad at middle or the terminal pair to 4 cm. broad, midrib not much stronger than the 2 or 3 parallel nerves on either side, all nerves converging somewhat toward base but the pinna not sigmoid; petiole 12–18 cm. long above the sheath, strongly ridged and angled as is the rachis: pistillate spadix small, of about 3 striate and angled erect glabrous rachillae 7–8 cm. long from the top of a very slender peduncle that is inclosed tightly in about 3 sheaths of which only the uppermost has a foliaceous end; sepals of pistillate flower very short and connate at base; petals much larger, nearly or quite free, imbricate, strongly nerved, pointed, soon spreading and chaff-like; pistil after fecundation short-oblong, obtuse.

Panama.

CHIRIQUÍ: cloud-forest at 6500 feet on Cerro de la Horqueta, Boquete region, *von Hagen & von Hagen 2060.*

Readily distinguished by its narrowly long-pointed or almost caudate leaflets and prominent loose petals of the pistillate flower, as well as by the short few branchlets of the inflorescence and lack of continuing rachis.

14. CHAMAEDOREA WEDELIANA Bailey, Gent. Herb. 6:247. 1943.

To 3 m. tall, very slender: leaf-blade 40–50 cm. long, thin, bright green both sides, pinnate, terminal part bilobed at apex and imperfectly 2-pinnatisect on either side; pinnae alternate and spaced 3–9 cm. apart on the rachis, lanceolate or broad-lanceolate or lanceolate and sigmoid, 16–22 cm. long, 3–6 cm. broad at middle, slenderly acuminate, considerably narrowed to base, strongly 4- to 5-ribbed and with indistinct veins between; petiole very short, about 6 or 7 cm. long above the sheath, striate, 3–4 mm. broad; rachis somewhat flattened, about 2 mm. broad: spadix slender and small; peduncle 30–40 cm. long, compressed, 3–4 mm. broad, bearing 5 or 6 sheaths; fruiting part terminal or nearly so, the rachis only 2–3 cm. long; rachillae 5, slender, 12–15 cm. long, loosely flowered: fruit ellipsoid, 12–14 mm. long, 6–7 mm. thick, tapering both ways, not fleshy and scarcely roughened in drying; cupule 3-lobed, not greatly enlarged, lobes spreading and striate inside, often remaining on the rachis.

Panama.

BOCAS DEL TORO: a "terrestrial shrub," Water Valley, *von Wedel 719*.

15. CHAMAEDOREA LINEARIA Bailey, Gent. Herb. 6:249. 1943.

Erect, slender, more or less 3 m. tall, culm about 1.5 cm. thick, internodes 2–3 cm. and more long, rings prominent: leaves long-pinnate, blade 30–45 cm. long and 20 cm. and more broad, glabrous; pinnae long-linear, alternate but close together, 15–20 or more either side the rachis, 25–30 cm. long, 2–3 cm. broad, not sigmoid but acuminate apices somewhat falcate, midrib pronounced and few side veins also noticeable, veins not clearly curved, base narrow and with nearly straight veins; petiole sheath 20 or more cm. long, strongly striate: staminate spadix with rachis 12–15 cm. long and about a dozen lateral slender glabrous spreading or drooping rachillae 10–12 cm. or more long; peduncle 20–25 cm. long, sheaths about 5 of which the terminal one is open and with a conspicuous bract; staminate flowers closely placed, about 1 mm. high just preceding anthesis and somewhat broader; calyx a shallow nearly entire cup; 3 petals valvate.

Panama.

CHIRIQUÍ: forests around El Boquete, 1000–1300 m., *Pittier 2922*.

16. CHAMAEDOREA PITTIERI Bailey, Gent. Herb. 6:252. 1943.

Erect, 60–100 cm. and perhaps more, the short caudex covered in the very expanded striate leaf-bases, at length becoming more or less evident from the falling of the leaves which are at the top of the broadened base and disclose strong rings 2–3 cm. apart, the culm itself about 1 cm. thick: leaves pinnate, glabrous or only minutely puberulent underneath, the blade 25–30 cm. long; petiole above the sheath very short, only 3–4 cm. long, stout, striate, grooved on upper face; rachis strongly ridged; pinnae alternate, narrowly lanceolate-acuminate, not sigmoid, firm, somewhat glossy at least underneath, 11–15 cm. long, 2.5 cm. or less broad at middle, long point sometimes almost caudate, tapering gradually to base, prominently and strongly many-nerved, the midrib usually not pronounced the whole length: peduncle arising from a central or upper axil, often 40 cm. long, slender, closely sheathed in 3 bracts; pistillate rachillae 2 or 3, erect or ascending from top of peduncle, 10–15 cm. long, alternately flowered; calyx small, lobed nearly or quite to base; petals separate, imbricate, somewhat striate: fruit oblong, obtuse, about 1 cm. long and 6 mm. broad, the soft thin exterior drying into more or less longitudinal lines, 3 micropyles prominent near basal end; cupule small, of flaring lobes.

Panama.

CHIRIQUÍ: southern slope of Cerro de la Horqueta, about 1700 m., *Pittier 3168, 3169;* rain forest, Bajo Chorro, Boquete District, alt. 6000 feet, *Davidson 188*.

A well-marked species in its very short petioles that are markedly expanded at base, narrow long-pointed strongly nerved pinnae, few short rachillae at top of very long axillary peduncle, fruit with prominent micropyles.

17. CHAMAEDOREA WENDLANDIANA (Oerst.) Hemsl. in Biol. Cent.-Amer. Bot. 3:407. 1885.

Stephanostachys Wendlandiana Oerst. in Kjoeb. Vidensk. Meddel. 1858:28. 1859.

Slender, 7 m. tall; trunk arundinaceous, green, about 3.5 cm. thick, bearing pronounced definite rings 3–4 cm. apart: leaves about 4, comprising the crown, irregularly pinnate, glabrous or perhaps slightly furfuraceous on nerves underneath, thin, glossy on upper surface, blade 1 m. and more long; pinnae 30–40, each 30–50 cm. long and 2–8 cm. broad, wide at attachment to rachis, long-acuminate to more or less falcate very narrow ends, the strong ribs 5–7 mm. apart; petiole 1 m. in length, long-sheathing, strongly angled, ridged on upper surface: spadix once-branched from the terete rachis, rachilla and rachis salmon-red, the glabrous rachillae strongly divaricate and 10–15 cm. long, peduncle 15 cm. more or less long and jointed and terete like a quill; alveoles or pits very shallow so that flowers and fruits are practically superficial: fruits oblong, 14–16 mm. long, and one-half as broad, green but turning black at maturity, obtuse, glabrous, the thin flesh making longitudinal ridges in drying; seed very hard, with homogeneous albumen.

Panama, Nicaragua, Costa Rica.

CANAL ZONE: Barro Colorado Island, *Bailey 32, 146;* Upper Río Pequiní, Madden Lake area, vicinity of Police Station, *Fairchild & Jobbins 2638;* Cerro Campo, trail from Campana to Chica, *Allen 2643.*

18. CHAMAEDOREA SCHERYI Bailey, Gent. Herb. 6:252. 1943.

Low, nearly stemless: leaf-blade long-pinnate, about 1 m. long, bearing 18–20 opposite or subopposite pairs of glabrous much ribbed pinnae; petiole 30 cm. or more long, much ribbed or ridged, glabrous; pinnae falcate or sigmoid-lanceolate, 20–25 cm. long and 3–4 cm. broad, midrib pronounced on upper surface, 2 minor ribs either side and indistinct nerves between, apex slenderly acuminate to almost caudate, base narrowed to about one-half the usual width but ribs hardly curved, the pairs standing 3–4 cm. apart on the thin flattened rachis: staminate spadix ample and diffuse, the flowering part about 25 cm. long and broad, consisting of a continuing central glabrous rachis and perhaps 24 slender divaricate or drooping simple rachillae 10–15 cm. long and closely flowered; peduncle 50 cm. or more long, erect, slender, inclosed in about 5 strongly striate sheaths, the upper one of which has a short acutely bifid end; staminate flowers 1–2 mm. long in full bud, divaricate, abruptly short-pointed, calyx 3-lobed and spreading, petals valvate.

Panama.

CHIRIQUÍ: vicinity of Bajo Chorro, alt. 1900 m., *Woodson & Schery 680.*

19. CHAMAEDOREA FALCARIA Bailey, Gent. Herb. 6:254. 1943.

Very slender, about 3 m. tall; trunk 1–1.5 cm. thick, rather closely irregularly ringed: leaf-blade 75–80 cm. long, with a pair of broad pinnae at base, another pair at apex and about 5 pairs of narrower ones between; petiolar sheath 20–25 cm. long (perhaps more), narrow and close-fitting, many-striate; rachis about 40 cm. long to base of upper bilobed part, flattened but slightly ridged above, more or less furfuraceous; lowest and apical pinnae about 30–40 cm. long and 5 or 6 cm. broad, narrowed to long slender point, not sigmoid but falcate in the

upper half, not narrowed nor the ribs curved to base, stoutly marked by 5 or 6 ribs 6–10 mm. apart with noticeable finer veins between, cross-veined on upper surface, practically glabrous on both faces; intermediate pinnae 1–4 cm. broad, falcate above the middle: fruiting spadix simply branched from a continuing rachis, about 20 cm. long and broad, the glabrous rachillae 12–16 cm. long; peduncle 4–5 cm. long, with about 3 joints where spathe-bracts have fallen: fruit oblong, 9–10 mm. long and 5 mm. thick, glabrous, nearly obtuse at apex, indistinctly striate when dry; cupule very small.

Panama.

COCLÉ: hills north of El Valle de Antón, alt. about 800 m., *Allen 2949*.

12. ROYSTONEA Cook. "Royal Palm"

ROYSTONEA Cook, in Science, ser. 2, 12:479, in note. 1900; Bull. Torr. Bot. Club 28:549. 1901.

Oreodoxa Kunth in HBK. Nov. Gen. et Spec. 1, quarto ed.:305; and folio ed. 1:244. 1815; not Willd.

Gorgasia Cook, in Nat. Hort. Mag. 18:112. 1939.

Very tall majestic columnar monoecious spineless feather palms, bearing a long crownshaft at apex of woody bole and at the base of it clusters of flowers and fruits, that is inflorescence and infructescence infrafoliar; trunk variously swollen, lightly ringed: leaves caducous from base of crownshaft; crown comprised of a large spreading or drooping canopy of many long leaves with drooping narrow pinnae and at the apex a long projecting sword-like unfolded new leaf: spadices at first erect or ascending, usually 2 or more together, comprised of 2 cymbae or spathes that eventually open on one side to liberate the cluster and to discharge the abundant meal (not pollen) within, one cymba falling early and often not observed, the inner much longer pointed cymba falling later with a crash or often hanging as a dead dry stave; spadix much branched, white, mealy, eventually becoming glabrous or retaining more or less pubescence: flowers scattered on the rachillae, not sunken, normally 1 pistillate between 2 staminates; sepals 3, very short, imbricate; petals longer, valvate; stamens mostly 6; pistil of 3 carpels, only 1 of which commonly develops into a globular or bean-like drupe-like 1-seeded fruit not exceeding about 2 cm. in longest diameter, the more or less pulpy sarcocarp providing food for pigs; micropyle and embryo basal.

Six or seven species in the West Indies, one of them also in southern Florida. None is known to be native in Panama but the trees are much planted and tend to be spontaneous, and Humboldt attributed his species *(regia)* to Panama but apparently *Oenocarpus panamanus* was mistaken for it. The Roystoneas are much planted in tropical countries around the world.

a. Pinnae on full-grown mature leaves in a single row or line either side the rachis, at least on the central or main parts of the leaf: fruit distinctly oblong and bean-like: crown of well-grown mature separate trees horizontal on the bottom or under side, very little if at all drooping so that the flower-clusters stand free against the sky ——— 1. R. OLERACEA

aa. Pinnae noticeably in two rows either side the rachis and the leaf therefore with a tousled look: fruit globular or short-pyriform: crown with drooping base, covering the clusters ..... 2. R. REGIA

1. ROYSTONEA OLERACEA (Jacq.) Cook, in Bull. Torr. Bot. Club 28:554. 1901.

Areca oleracea Jacq. Select. Stirp. Amer. Hist. 1:278, *t. 170*. 1763.
Oreodoxa oleracea Mart. Hist. Nat. Palm. 3:166, *tt. 156, 163*. 1837.
Gorgasia oleracea Cook, in Nat. Hort. Mag. 18:114. 1939.
Gorgasia maxima Cook, loc. cit. 1939.

To 40 m. and perhaps somewhat more in native forests, prominently bulged at base, usually more or less bulged also at the middle or above but in age becoming more uniform: leaves 3–7 m. long, 2 m. broad at middle, with 100 or more closely placed pinnae as much as 5 cm. broad, leaves with a flat look due to the simple arrangement of parts: spadix branches undulate or waved, at least when in cymba and after release: fruit oblong and usually somewhat curved, 15–20 mm. long, 9–10 mm. thick, purplish to black: note contrasts in key.

Farther West Indies islands, as on Trinidad, Tobago, Barbados, Martinique. A stately tree; known as the *Caribbee Royal Palm*.

2. ROYSTONEA REGIA (HBK.) Cook, in Science, loc. cit. 1900.

Oreodoxa regia HBK. Nov. Gen. et Spec. loc. cit. 1815.

Variable tree, usually not exceeding 25 m. in height, trunk not uniformly columnar but swollen at or near the middle and commonly at the base: leaves shorter and pinnae fewer in each line or row, with a brush-like look, pinnae 3–4 cm. broad: spadix branches not undulate: fruit long-globose to nearly globular, somewhat narrowed to base, 8–13 mm. long and approximately 10 mm. thick, red-brown or purplish at maturity.

Cuba; the *Cuba Royal Palm*, now most widely distributed of the species as a planted and spontaneous tree.

13. WELFIA Wendl.

WELFIA Wendl. in Gartenfl. 18:242. 1869.

Tall single-trunked monoecious pinnate-leaved unarmed palms bearing a dense high crown of ascending-spreading long leaves: spadices infrafoliar, pendent, the thick heavy angled rachillae several from a very short peduncle, bearing flowers and fruits in deep pockets or cavities in several lengthwise rows; cymbas 2, ridged on back, soon deciduous: flowers large, whitish or ochroleucous, typically in 3's with pistillate in middle but usually more or less scattered, all sunken in pits provided with a pronounced lid or lip; staminates with narrow or lanceolate imbricate sepals and a cylindric corolla with obtuse valvate lobes, stamens many, the filaments united, pistillode minute or none; pistillate flowers about the size of the staminates, with imbricate free sepals and much larger imbricate petals two of which are boat-shaped and keeled, staminodia present in the form of teeth in the tube: fruit oblong or ellipsoid with basal stigma; seed with elongated lateral hilum, albumen equable.

Three species, Honduras to Colombia.

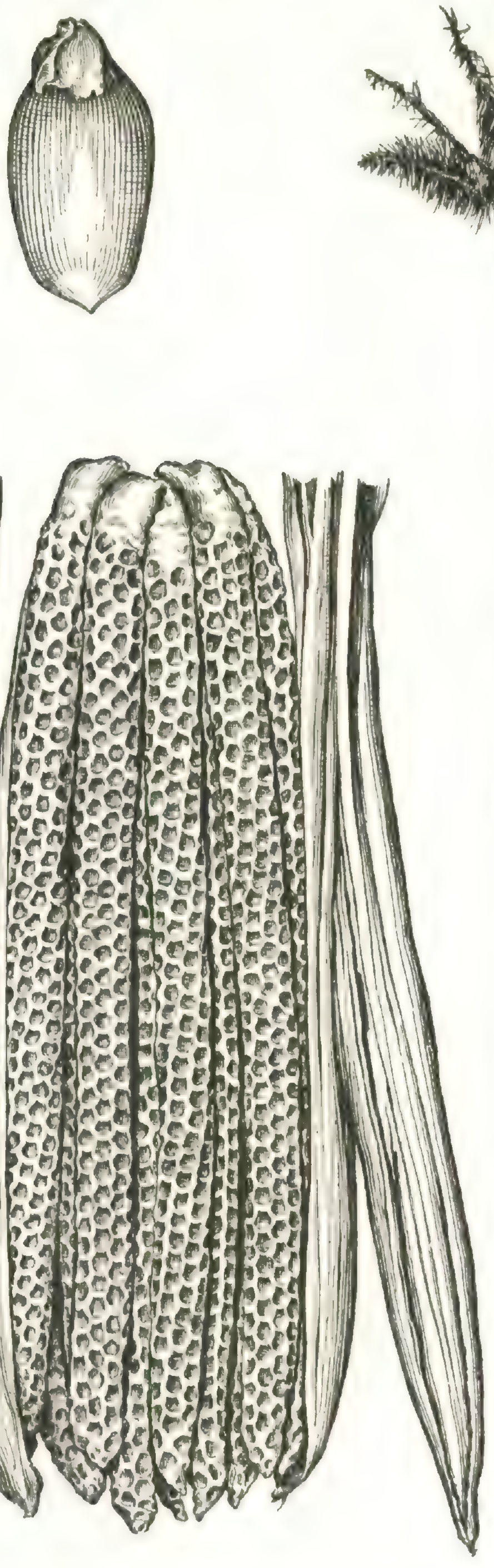

Fig. 59. *Welfia Georgii.* Alveoles at A and B.

1. WELFIA GEORGII Wendl. ex Burret, in Engler's Bot. Jahrb. 63:125. 1930.

Commanding tree 20 m. and more tall, trunk obscurely ringed with leaf-scars, 30 cm. diameter, without a crownshaft: leaves evenly both oppositedly and alternately pinnate, glabrous but petiole and rachis more or less furfuraceous, blade 3–4 m. long or twice that length on large trees; petiole 1 m. long and, with the rachis, strongly ridged; pinnae often above 150, from 50 to 75 cm. long to 1 m. and more for the larger ones, and 3.5–5.5 and up to 11 cm. broad, narrowly pointed, reduplicate at base, strongly many-ribbed and midrib usually not clearly separable, splitting lengthwise in age into narrow strands and appearing therefore to be multiple: main cymba 60 cm. long, woody, many-ribbed and furrowed and splitting with age; spadices 1 or 2 at one time, peduncle flat and stout and about 10 cm. long from which several stout rachillae 30–40 cm. hang close to the trunk, the heavy rachillae octagonal and about 3 cm. thick with rows of flowers sunken deep in pits: fruit oblong-ellipsoid or almond-like, tapering in both directions, 3.5–4.5 cm. long and 17 mm. thick, glabrous; seed 1, albumen equable.

Panama, Costa Rica. First described from Sarapiqui River, northeastern Costa Rica; collected on Rio Hondo, Plains of Santa Clara, Costa Rica. Costa Rican and Panamian trees need to be critically compared, as well as the insufficiently described *W. regia* of Colombia. Called *Palma Conga*.

CANAL ZONE: Quebrada Lopez, *Allen 2112*. COCLÉ: vicinity of La Mesa, El Valle de Antón, *Allen 2565*.

14. EUTERPE Gaertn.

EUTERPE Gaertn. Fruct. et Semin. Pl. 1:24. 1788.

Slender but mostly tall tree palms, monoecious, unarmed, trunk ringed, solitary or plant soboliferous, leaves pinnate, pinnae gradually narrowed and acuminate, sheaths of the petioles forming a conspicuous crownshaft, spadix infrafoliar, in general somewhat like *Roystonea* in appearance but without the stout columnar trunk and the enormous hanging fruit-clusters of that palm, with a less pronounced crownshaft and a very different fruit: spadix with long slender drooping branches or rachillae that are not attached to rachis by a suddenly expanded base; spathes 2, cymba-like: flowers staminate and pistillate in the same spadix, typically in 3's with the middle one pistillate but usually irregular in this respect and the upper end of the rachilla mostly staminate, free or only partially immersed in the axis; sepals very small, pistillate petals valvate; stamens 6: fruit small, globose, 1-celled, drupe-like, with more or less succulent exterior but soon drying hard into a fibrous covering of the nutlet or seed, not immersed in the rachis, stigma lateral or at least not apical, embryo mostly lateral but sometimes super-lateral or basal; albumen either plane or ruminate.

About 50 species in the West Indies and from Nicaragua to South America, only one species *(E. panamensis)* having been reported heretofore from Panama.

For our purpose we may divide the genus into two sections: Euterpotypus Burret (*Euterpe* proper) in which the fruits have ruminate or much-divided albumen from intrusions of the walls; Euterpopsis Burret, with plane or non-ruminate (clear solid white) albumen.

a. Albumen of the seed conspicuously ruminate: pinnae tending markedly to split as if dividing into 2 or more: rachillae colored, glabrous, very slender, about 1–2 mm. thick when dry ..... 1. E. ROSEOSPADIX
aa. Albumen plane (white and not divided): pinnae with little tendency to split: rachillae white, pubescent, 4–5 mm. thick ..... 2. E. PANAMENSIS

1. EUTERPE ROSEOSPADIX Bailey, Gent. Herb. 6:201. 1943.

Erect, to 2 m.: leaves pinnate, glabrous unless for minute puberulence under a lens on bottom side; leaf-blade 1.5 m. or more long, 1 m. broad at middle, pinnae opposite and alternate at different parts of the rachis, the rachis triangular in section and ridged; pinnae 25 or more on either side of rachis, long-linear, the main ones 50 cm. long and 4–5 cm. broad at middle, tapering to narrow points but not caudate, splitting at the base as if two or three of them were attached together, midrib prominent and on the under surface more or less lepidote, side-veins less pronounced and few; petiole 1 m. long, somewhat flecked or lepidote but perhaps becoming glabrous, concave on upper face, ridged on lower face: spadix bright pink, glabrous or becoming so; rachillae 30–40 cm. long, very slender and only 1–2 mm. thick when dry, branched, angled in drying, rather closely flowered; staminate buds at anthesis 5–6 mm. long, 2–3 mm. thick, prominently pointed; pistillate buds 2–3 mm. long, not pointed: fruit nearly globular but oblique, 9–10 mm. thick either way when dry, stigmatic point pronounced but not central, cupule applanate and conspicuous; seed with tessellate exterior, solid and white in center, ruminate one-half or more the diameter with coarse projections from the walls.

Panama; known as *Manaca*.

CHIRIQUÍ: vicinity of Bajo Chorro, alt. 1900 m., *Woodson & Schery 623*.

2. EUTERPE PANAMENSIS Burret, in Notizbl. Bot. Gart. u. Mus. Berlin 11:864. 1933.

Caudex about 4–5 cm. diameter: leaves regularly pinnate, the pinnae opposite, spreading, linear, 30–40 cm. long, about 3 cm. broad, very narrowly acuminate and the acumen filiform; midrib and usually the large nerves on under surface provided with brownish scales, the lower face strongly covered with numerous very minute cinnamon-colored scales and minutely puberulent; leaf-sheath 75 cm. long, costate, brownish-scaly but becoming glabrous; petiole 12 cm. long above the sheath, rounded on back, furrowed on upper face, about 13 mm. thick at apex; rachis brownish-scaly or ferrugineous: spadix small, white-tomentose, the hairs very minute and dense; peduncle 7–8 cm. long, clasping at base; rachis about 16–17 cm. long; rachillae about 30, drooping, about 50 cm. long, densely provided with spirally arranged foveae or depressions in which flowers and fruits are placed, white in color and very finely closely pubescent, in the main part 3–5 mm. thick when dry: mature fruit not described.

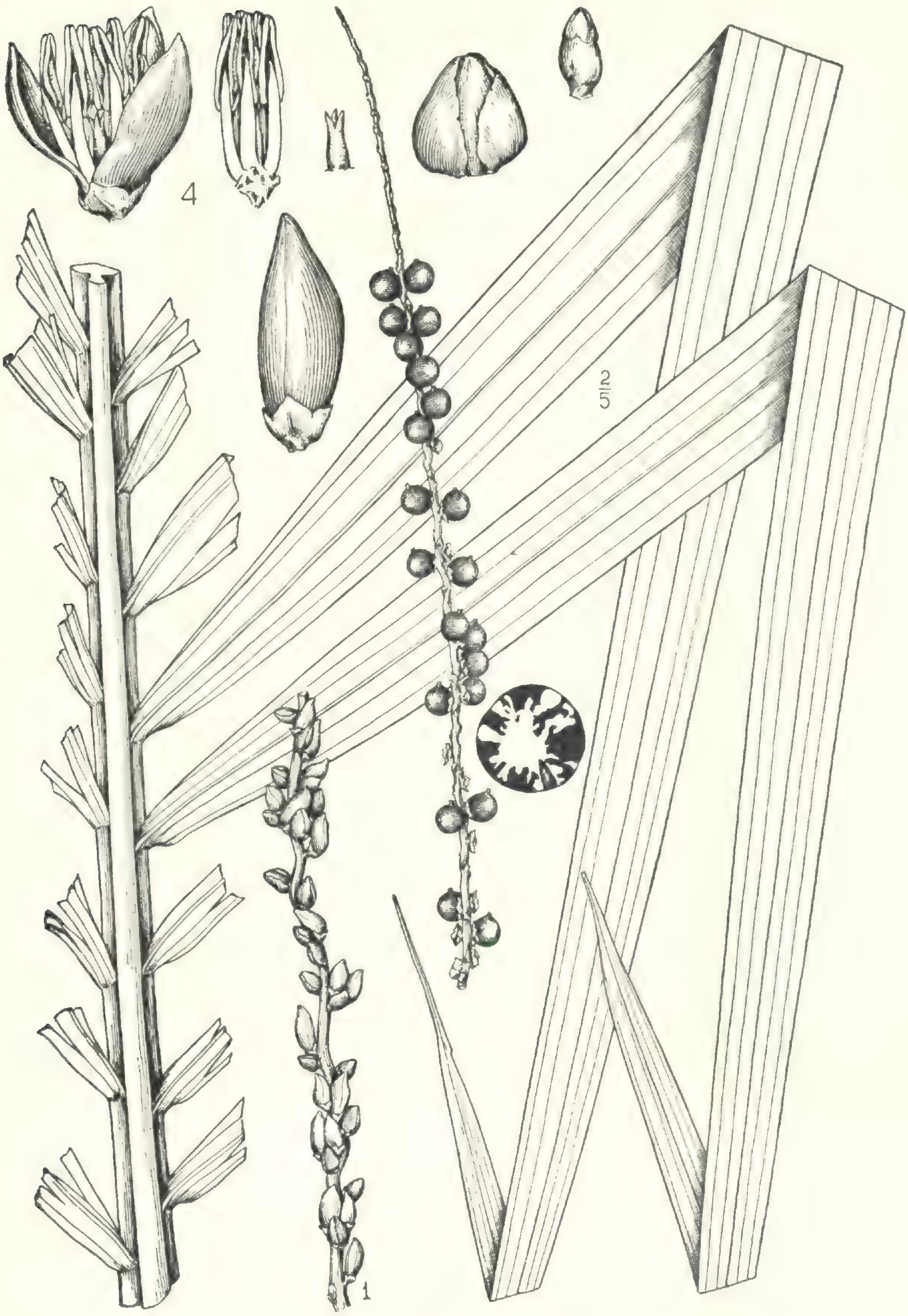

Fig. 60. *Euterpe roseospadix*

Panama. Assigned by Burret to the section Euterpopsis. Called *Raviorcao*.
CANAL ZONE: Aqua Salud, *Cook & Martin 59*.

Probably *Euterpe panamensis* is a widespread and variable palm in Panama. The material available for the original diagnosis was not sufficient for full definition and fruit was not available. Two collections by P. H. Allen, *2534, 2940*, in the region north of El Valle, Coclé, probably belong here although apparently larger palms than *E. panamensis* as first described. Allen makes the following comments on variation in size and habit:

"This is seemingly by far the commonest *Euterpe* of the Valle region. The plants are variable, depending on conditions under which they have developed. Poor soil and steep rocky windswept slopes develop slender comparatively dwarf invariably single-stemmed trees, often less than three inches in diameter, and fruiting when not more than twenty feet tall. In favorable situations they occasionally produce three or four trunks from a common base, which seems to be rather the exception. Well-developed specimens have gray obscurely ringed trunks, averaging about six inches in diameter, and fruiting when fifty or sixty feet tall. The basal portion of the trunk is supported by more or less stilt-like lacquer-red roots, these forming a buttressed mound averaging a foot in height. In all specimens, the albumen is consistently plane, and the embryo directly basal."

Mature fruits of the Coclé palm are variable in size and shape, shortly globular-oblong and more or less oblique, 8–10 mm. thick, black, glabrous, style persistent, cupule large and applanate; seed ornamented with rapheal veins, albumen homogeneous, embryo basal.

15. OENOCARPUS Mart.

OENOCARPUS Mart. Hist. Nat. Palm. 2:21. 1823.

Arboreous unarmed pinnate-leaved monoecious palms with solitary or clustered trunks, some of the species south of Panama having the foliage arranged distichously in the crown or head: inflorescence infrafoliar, borne below a crownshaft; flowers unisexual, not immersed, normally a pistillate between two staminates but on most rachillae the pistillates missing on the apical part of the strand; stamens 6, the sepals and petals both valvate or perhaps indistinctly somewhat imbricate at base, pistillodium usually evident; pistillate flowers much shorter than the staminates, sepals and petals imbricate, staminodia usually not evident: fruit a 1-seeded drupe-like small ovoid or globose body with more or less fibrous or sometimes succulent exterior, stigma terminal or nearly so; seed with plane albumen, embryo basal.

South American palms, one species in Panama; about 16 species, not well understood. Perhaps the genus will be divided when better known.

1. OENOCARPUS PANAMANUS Bailey, Gent. Herb. 3:71. 1933.

Graceful and slender but tall palm growing in small clumps usually with trunks of different ages, 25 m. and perhaps more tall, with a "smooth" look, the boles bamboo-like and ringed but not indented or notched, to 15 cm. thick; crownshaft blackish-green: leaves long-pinnate, glabrous, 2 m. and more, spreading and downwardly curved; pinnae alternate, about 60 either side the concavo-convex

rachis, 50–80 cm. long, 4 cm. or less broad, long-pointed, unequally bifid at apex, 2–3 ribs either side the midrib; petiole to 1 m. long, slender, terete except with deep narrow groove on upper side: spadix with short peduncle or handle, 15–25 cm. long, from which depend many scurfy-pubescent rachillae 40–75 cm. long, closely flowered except the tip which is naked for 2–5 cm.; spathe double, outer part of 2 woody valves 20–25 cm. long, inner or persistent part a tomentose tube or sleeve 30–40 cm. long that splits on one side; staminate flowers 3–5 mm. long in full bud, stamens 6 with short filaments and versatile anthers: fruit near base of rachillae that make prominent hanging cluster, black with hard exterior, short-ovoid to obscurely obovoid, 2–2.5 cm. long, with very short abrupt point; nutlet tightly inclosed in fibers, nearly globular, albumen white, center cavitous.

Panama. Called *Maquenque*.

CANAL ZONE: in woods, Barro Colorado Island, *Bailey 75* (TYPE). The tree may be mistaken for a *Roystonea*, and such confusion apparently led to the early assignment of *R. (Oreodoxa) regia* to Panama.

16. PRESTOEA Hook. f.

PRESTOEA Hook. f. in Benth. & Hook. Gen. Pl. 3:899. 1883; Bailey, Gent. Herb. 4:382. 1940.

Small trees of the *Euterpe* kind but without crownshaft above spadices or flower-clusters, pistillate spadices with short ascending or divaricate rather than long slender and drooping rachillae and that are attached to rachis by a swollen or bulboid base, petals of pistillate flowers convolute-imbricate rather than valvate: fruit gibbous or lop-sided; seed lacking a fibrous covering and with a marbled or tessellate exterior; albumen strongly ruminate.

Three species distinguished in the farther West Indies, one in Panama, one known only in cultivation some fifty years ago in England said to have come from Guatemala.

1. PRESTOEA SEJUNCTA Bailey, Gent. Herb. 6:201. 1943.

Erect small tree, 5 m. or more tall; trunk about 5 cm. diameter, woody and hard, with pronounced rings about 3 cm. apart, bearing a crown of 4–8 mature pinnate leaves and devoid of a regular crownshaft: blade of main leaves nearly 2 m. long, with 70–80 subopposite pinnae on a triangular red rachis; pinnae at mid-leaf 60–65 cm. long, 3.5–4 or 5 cm. broad, glabrous, margins more or less thickened or ribbed, midrib prominent, side-ribs markedly subordinate, long-acuminate, the lower ones essentially caudate; petiole with a split and clasping base 6–7 cm. across, nearly 1 m. long, concavo-convex in section: spadices infra-foliar, erect, close to the coma or crown of leaves, about 4 in number; spathe-valves 2, the outer about 20 cm. long, inner or main one 75–80 cm. long, 2–2.5 cm. broad before dehiscence, bearing reddish-brown furfur; peduncle of spadix red, terete but perhaps angled in drying, 25–30 cm. long, passing into a continuing rachis 30 and more cm. long; rachillae about 25, pinkish, strongly ascend-

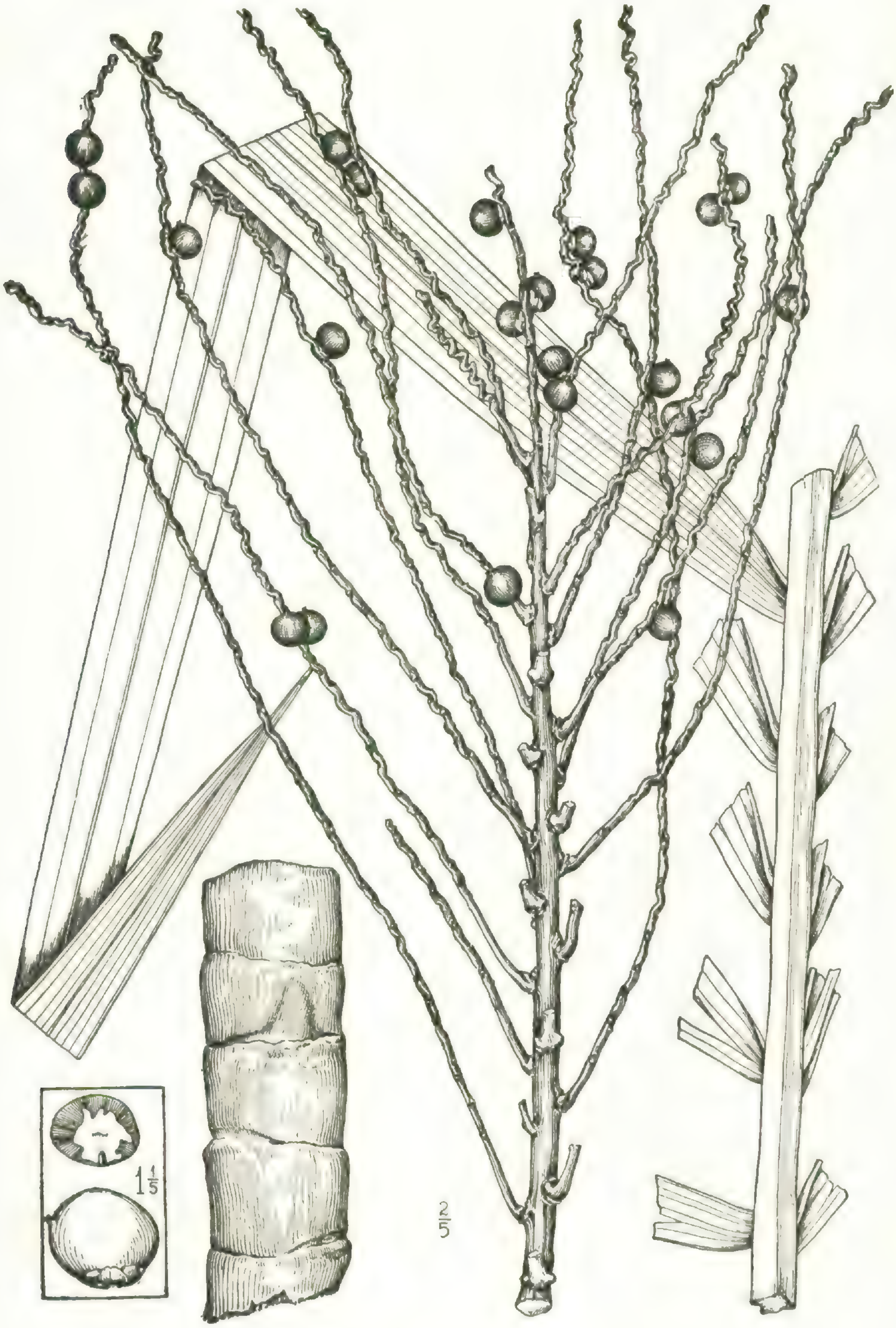

Fig. 61. *Prestoea sejuncta*

ing, 30–70 cm. long, glabrous, much swollen at base just as they join the rachis; flowers in shallow depressions on the rachillae: fruit depressed-globose, black, 10 mm. high and 11–12 mm. thick, lop-sided and stigmatic point off-center, cupule of more than 6 parts and applied tightly to the surface; seed irregularly depressed-globular, loose inside a thin inner mesh, about 8 mm. across the long way, surface tessellate, basal scar very broad; albumen ruminate, being filled with brown partitions that extend to the cavitous center.

Panama. This makes five recognized species of the neglected genus *Prestoea*, which lacks the crownshaft of *Euterpe* and differs in floral and fruiting characters.

CANAL ZONE: vicinity of Police Station, upper Río Pequini, Madden Lake area, *Fairchild & Jobbins 2635*. COCLÉ: El Valle de Antón, about 1000 m., vicinity of La Mesa, *Allen 2740*.

17. WOODSONIA Bailey

WOODSONIA Bailey, Gent. Herb. 6:262. 1943.

Geonomoid pinnate-leaved monoecious palm with chaff-like flowers in a long narrow simple spadix like that of the grass *Ammophila*, the pistillate beneath or more or less between 2 pointed striate staminates, all of them only lightly immersed on the rachis; staminate flowers 6–7 mm. long in full bud, with short 3-pointed calyx cupulate at base, 3 long narrow pointed slightly imbricate petals free and hardly united at base somewhat exceeded in anthesis by 6 long linear versatile conjoined anthers on separate filaments only moderately widened toward base, pistillode columnar with 3 pointed stigmas; pistillate flowers much shorter, envelopes imbricate and about equal in both series, ovary about 1.5 mm. long, somewhat oblate and narrowed into a conical part; albumen apparently ruminate.

1. WOODSONIA SCHERYI Bailey, Gent. Herb. 6:262. 1943.

Erect, 2–3 m. tall: leaf-blade 1 m. or more long and 75 cm. broad with 14–20 long-linear pinnae either side of rachis; pinnae 35–45 cm. long, 3–5 cm. broad, tapering to long thin point, glabrous or perhaps minutely puberulent underneath, somewhat glossy, subopposite and alternate and sometimes missing, attached 5–10 cm. apart, midrib not very prominent and several side-ribs nearly as strong and 5 mm. more or less apart; petiole 60–70 cm. long, expanded at base, narrowly grooved on upper face at lower end but becoming strongly angular and more or less 4-sided: spadix 30–45 cm. long, 10–14 cm. thick, tapering to top, terminating a slender peduncle of equal or greater length, the main spathe a single tight sheath produced into a narrow blade that equals the inflorescence; flowers compactly placed, white, becoming stramineous, the buds at anthesis having an upright or ascending direction and loosely imbricating; staminate buds at anthesis period 6–7 mm. long when dry, curved, prominently pointed; pistillate buds at same period 3–4 mm. long and hardly pointed.

Panama.

CHIRIQUÍ: vicinity of San Bartolomé, Peninsula de Burica, alt. 0–50 m., *Woodson & Schery 894*.

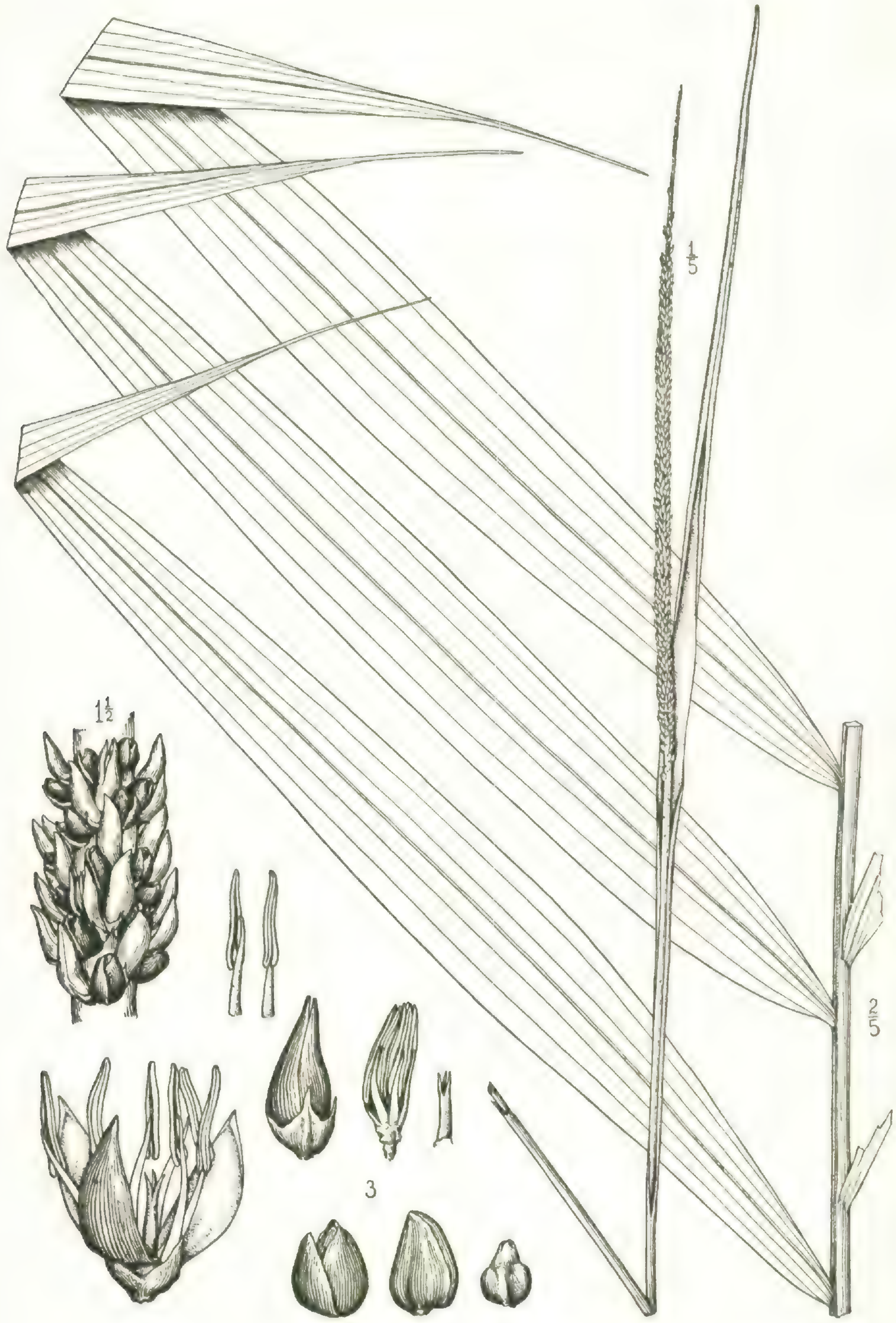

Fig. 62. *Woodsonia Scheryi*

18. NEONICHOLSONIA Dammer

NEONICHOLSONIA Dammer, in Gard. Chron. ser. 3, 30:178-9. 1901. Fig. 56A mistakenly legended "*Asterogyne Martii.*"
Bisnicholsonia O. Ktze. in Post & Ktze. Lex. Inserenda and p. 621. 1904.

Geonomoid pinnate-leaved acaulescent monoecious palms with very long and slender simple spadix continuing the long peduncle, distinguished technically by the long stamens united only at base, anthers somewhat sagittate, the two cells joined by a thin connective or intermediate tissue that extends between and beyond the apex of the anthers into a mucro, pistillode short with 3 styles united at base; flowers lightly immersed on the rachis.

Two species in Costa Rica, one of them reported also in Panama; little known. Described originally from cultivation under glass in Europe, fruits not reported.

1. NEONICHOLSONIA GEORGEI Dammer, loc. cit. 1901.

Leaves pinnate, glabrous, to 2 m. long; pinnae alternate or the lower ones opposite, 10–11 on either side of rachis, lanceolate and long-acuminate, 30–36 cm. long and 8 mm.–5 cm. broad, placed 5–10 cm. apart, terminal pair confluent at base, midrib pronounced, main lateral nerves 2 on either side; petiole quadrangulate and about 48 cm. long and vaginate for 20 cm.; rachis about 70 cm. long: spadix without peduncle 55 cm. long and 5 mm. thick when dry, the slender peduncle of similar length; alveoles partially raised above the surface of the glabrous axis of the spadix and rimmed like a saucer with the short floral envelopes remaining after flowering stramineous and striate and as broad as long: immature fruit conic, truncate at apex.

Panama.

CHIRIQUÍ: Cerro de la Plata, near San Felix, eastern Chiriquí, in forests, alt. 120–150 m., *Pittier 5167.*

19. SYNECHANTHUS Wendl.

SYNECHANTHUS Wendl. in Bot. Zeit. 16:145. 1858.

Slender small and usually inconspicuous unarmed glabrous monoecious shade-loving palms with infrafoliar inflorescences: leaves irregularly pinnate or pinnatisect: peduncle as long as the flowering part of the spadix, erect, arising from a sheath and itself covered in close-fitting sheaths that soon become dry and perhaps shreddy: flowers minute in lines or little acervuli on very slender ascending rachillae, several together, of which the basal one is pistillate and the others staminate, not sunken in the axis; petals valvate in the bud in the staminate flower and convolute-imbricate in the pistillate, more or less connate at base; stamens 6: fruit oblong, small, slightly succulent; albumen white, intruded by projections from the walls.

Three species, Guatemala, Costa Rica, Panama.

1. SYNECHANTHUS WARSCEWICZIANUS Wendl. loc. cit. 1858.

Tree to 5 m. tall, with single green ringed arundinaceous trunk 2–3 cm. thick, sometimes with brace-roots at the base: leaves irregularly pinnate, glabrous, the blades 1 m. and more long and bearing 8–10 subopposite drooping pinnae or segments either side the very slender angled rachis; pinnae or parts from 1 to 12 cm. broad and 30–50 cm. long, lanceolate and long-pointed, lacking midrib but provided with several or many strong parallel nerves 5–10 mm. apart; petiole 50–75 cm. long, slender, smooth, grooved on upper face, sheathing at base: spadix a broom-like structure with 20 or more very slender ascending or divaricate rachillae arising from a continuing and terminating an erect completely sheathed peduncle; flowers very small and often overlooked, flat-topped, 4–9 of them in alternating acervuli, of which the basal one is pistillate: fruit oblong, 15 mm. long, lemon-yellow to light orange but drying black, sparse on the rachillae inasmuch as the pistillate flowers are single in each of the scattered acervuli; albumen invaded by lateral dark-colored projections.

Panama. Originally described from Costa Rica.

CANAL ZONE: Barro Colorado Island, *Bailey 523;* Quebrada Ancha, *Dodge & Steyermark 17047;* Quebrada Lopez, *Allen 2133.*

20. HYOSPATHE Mart.

HYOSPATHE Mart. Hist. Nat. Palm. 2:1. 1823.

Arundinaceous small erect spineless glabrous pinnate-leaved or pinnatisect monoecious palms with infrafoliar inflorescences: flowers small, in branched spadices, on long slender rachillae, normally 1 pistillate between 2 slender staminates but placement often irregular; spathes long and slender, at base of spadix and at first inclosing it; staminate flowers with 3 long narrow valvate petals and 3 small connate sepals, stamens 6; pistillate flowers much smaller, sepals and petals imbricate, pistil 3-loculed, staminodia present: fruit a small ellipsoid drupe-like body, 1-seeded, scarcely fleshy, about 1 cm. long; embryo basilar.

About a dozen South American species, one of them in Panama. *Hyospathe pubigera* of Trinidad is *Prestoea pubigera* Nichols.

1. HYOSPATHE LEHMANNII Burret, in Notizbl. Bot. Gart. u. Mus. Berlin 11:859. 1933.

Trunks few or many, sometimes as many as 25, cane-like, 2.5–5 cm. thick, 2.5–3.5 m. tall, nodal rings well marked: petiole with long clasping basal sheath; leaves with free part of petiole 50–60 cm. long, irregularly pinnate; main pinnae, as at bottom and top, 4–7 cm. broad and strongly many-ribbed, intermediates 1–4 cm. broad, long narrow-pointed, 25–35 cm. long: spathes 2, inner or main one 30–35 cm. long, outer one somewhat shorter, narrow, smooth and glabrous; spadix divaricate, peduncled, rachillae 12–30, slender, 20–30 cm. long, profusely flowered: flowers purple or reddish in bud; staminates 4–5 mm. long and about

1 mm. thick, pointed: fruit not described.

Panama. Species founded on collections near Buenaventura, Colombia, by F. C. Lehmann.

COCLÉ: vicinity of El Valle de Antón, *Allen 2066.*

21. GEONOMA Willd.

GEONOMA Willd. in Mém. Acad. Sci. Berlin 1804:37.

Small unarmed monoecious palms, either bushes or low trees, trunks ringed and often arundinaceous: leaves pinnate, pinnatisect or at least pinnately veined: spadices interfoliar or infrafoliar, either a simple spike or somewhat branched; spathe not cymba-like: flowers partially or deeply immersed in the rachilla or rachis, morphologically 1 pistillate between 2 staminates but this disposition not always the pattern, in which case the upper part of the rachilla may be almost or quite uniformly staminate; floral envelopes 6 in two series, calyx and corolla, the parts or lobes usually imbricate in the bud except that the corolla parts of the staminate flowers are commonly valvate; stamens 6, as also the staminodes in the pistillate flower, the filaments in both cases united into a dentate or lobed tube that, in connection with the separated spreading anther-cells, constitutes the particular mark of the genus; ovary sitting in a free disk or cushion, 3-loculed, style lateral or near base, stigmas 3, 1 or 2 locules abortive: fruit a very small drupe-like 1-seeded globular or ovoid or somewhat pyriform body, the mesocarp more or less fleshy and only seldom edible; seed with basal hilum, albumen equable.

Well toward 200 species from Mexico and Hispaniola to Peru, Bolivia and Brazil; many species in the Amazon region, more than 60 in Colombia. Woods palms of minor size. The genus was founded on two species of Venezuela.

Genus *Calyptrogyne* may be represented in Panama but materials are not yet sufficient to work out the case. It differs from *Geonoma* in the sagittate basifixed anthers, the anther-cells not discrete or separated on minute pedicels, style central rather than lateral or sub-basal, fruit 3-loculed, often obovoid. *Calyptrogyne* is a small group native in Mexico, Central America, parts of South America. They are arundinaceous small palms; arboreous plants of the Antilles sometimes referred to the genus are properly *Calyptronoma.* Perhaps some of the species described in *Geonoma* may be determined as *Calyptrogyne* when flowers and mature fruits are better known.

a. Spadix or flower-cluster simple, on a long slender peduncle ascending from a lower axil or near the ground, unbranched, comprised of either 1 straight thin spike or of a few straight spikes standing finger-like at top of peduncle, the cluster lacking an elongated rachis or axis; spathe of 1 or 2 narrow sheaths on peduncle.

b. Spike 1 on the peduncle, strictly terminal.

c. Leaf-blade habitually entire (of one piece) although bilobed at apex or sometimes its base somewhat and irregularly split or pinnatisect into more or less separate parts: trunk very short, or little noticeable above the ground.

d. Terminal lobes of leaf straight ..... 1. G. DECURRENS

dd. Terminal lobes curved toward the top or falcate ..... 2. G. OBOVATA
cc. Leaf-blade habitually pinnate, with distinct separate pair or pairs of pinnae (*G. obovata* is not to be sought here): trunk usually evident.
d. Pinnae long (40–50 cm.), straight to apex, not tailed, often very narrow, strongly costate, gray-green: fruit large, 15 mm. or more long ..... 3. G. COSTATIFRONS
dd. Pinnae otherwise: fruit 12 mm. or less long.
e. Apex of pinna a very slender cauda or tail, and abruptly narrowed; pinnae short (25 cm. or less) ..... 4. G. ALLENII
ee. Apex of pinna curved or falcate, not caudate; pinnae 30 cm. or more long.
f. Pairs of pinnae 1 or 2, with rachis below the terminal part vacant for 10 or 12 cm. ..... 5. G. CONDENSATA
ff. Pairs of pinnae several or many and close together ..... 6. G. PROCUMBENS
bb. Spikes few or several attached at apex of slender peduncle and radiating or spreading therefrom, the axis of the cluster very short or none ..... 7. G. SIMPLICIFRONS
aa. Spadix compound, with branches extending from a central rachis, the peduncle short and spreading from the trunk in an upper axil; spathe cymba-like at base of stout peduncle.
b. Rachillae short, 10 cm. or less long, simple or once-forked.
c. Pinnae few, these and the terminal lobes 8–12 cm. broad, the tips caudate ..... 8. G. CONGESTA
cc. Pinnae many pairs, 5 cm. or less broad, the tips acute or acuminate ..... 9. G. FERRUGINEA
bb. Rachillae slender, 20–30 cm. long, drooping in a much-branched very compound cluster: leaf-blade divaricately pinnate ..... 10. G. BINERVIA

1. GEONOMA DECURRENS Wendl. ex Burret, in Engler's Bot. Jahrb. 63:162. 1930.

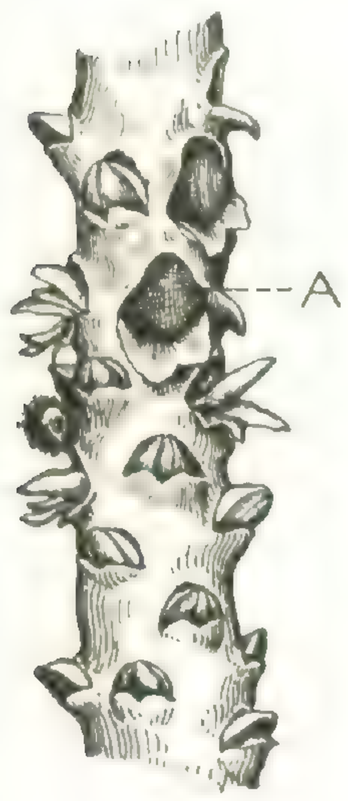

Fig. 63 *Geonoma decurrens* A, alveole or pit left by the fallen fruit.

Fig. 64 *Geonoma procumbens*

Erect, trunk to 2 m. tall and 4 cm. thick but sometimes little noticeable above the ground: leaves 8–10 at top of trunk, 1 to nearly 2 m. long, 20–30 cm. broad toward apex and narrowing to base, thin in texture, pinnately veined and simple but deeply 2-lobed at apex, all apices straight, sometimes irregularly split on one side or the other into what look like narrow separate pinnae, the blade decurrent on petiole, glabrous or perhaps somewhat furfuraceous on petiole, rachis and often on the numerous very strong veins: spadix a simple slender spike 30–40 cm. long, drooping on a slender flattened long peduncle which is sheathed by spathe at base, spike commonly unisexual, all the flowers sunken in the axis; staminate flowers whitish, conspicuously projecting at anthesis, filaments united in a tube, anthers separated by an orange connective; pistillate flowers purplish, usually exserted, staminodes represented in a tube, stigmas 3 and pronounced: fruit ovoid or broad-ellipsoid, 7–8 mm. long and 5–6 mm. the flatter way, glabrous, light greenish-yellow.

Panama, deep woods, probably widespread. Costa Rica.

CANAL ZONE: Barro Colorado Island, *Bailey 125; Standley 40896;* Quebrada Ancha, *Steyermark & Allen;* Quebrada Bonita, *Dodge & Allen 17126.* COCLÉ: vicinity of El Valle de Antón, *Alston & Allen 1838; Woodson & Schery 173.* BOCAS DEL TORO: Isla de Colón, *Woodson, Allen, Seibert 1946; von Wedel 488.*

2. GEONOMA OBOVATA Wendl. ex Spruce, in Jour. Linn. Soc. Bot. 11:104. 1871.

Small plant, trunk 50 cm. high and 15–20 mm. thick: leaves long-petioled, the blade simple or somewhat pinnatisect, ambitus or outline obovate-cuneate, deeply bilobed at apex, 1 m. or somewhat more long and 20–25 cm. broad, with 20–30 strong nerves either side the rachis or some of the few divisions (when the blade is split) with about 7 nerves, apices sharply acuminate and curved or falcate, somewhat brown-hairy underneath at least when young: spadix arising from between the lower leaves, the flowering simple spike 10–20 cm. long, dense, narrow spathe-sheaths conspicuous on the lower part or to middle of the slender erect peduncle: fruit not described.

Panama, Costa Rica.

PANAMÁ: Mt. Pirri, *Goldman 1970* (det. Burret).

3. GEONOMA COSTATIFRONS Bailey, Gent. Herb. 6:206. 1943.

Slender, 3–4 m. tall, glabrous unless scurfy on petioles: leaves unequally pinnate; blade about 1 m. long; petiole 75 cm.–1 m. long, firmly clasping for perhaps one-third its length, very slender, flattish on under side and 5–10 mm. across, sharply ridged on upper surface; pinnae 40–50 cm. long and 3–8 cm. broad with middle 3–4 cm., long-tapering rather abruptly into a narrow end and usually (as narrower ones intervening or near the apex, alternate and opposite, about 2 or 3 main pairs aside from a terminal broad pair and sometimes terminal very narrow shred-like units, all of them with broad base from which extend several or many costae or ribs prominent on both surfaces and yellowish underneath and between which the pinna tends to split lengthwise, all very gradually and straightly tapered to long narrow point, placement of the pinnae often far apart on the rachis sometimes as much as 12 cm., so that the leaf may have an open or skeletonized look: spadix a simple spike to 30 cm. or more long on an angled glabrous peduncle two to three times as long and subtended at the base by a very long narrow leaf-like spathe; axis of spadix glabrous, the pits distinctly separated and its lower lip retrorse and striate after anthesis: fruit (yet immature although apparently about full size) oblong-pyriform, 15–16 mm. long, 10 mm. broad toward apex which is obtuse, glabrous, drying roughish.

Panama.

rachis and not always precisely opposite, length about 20–25 cm., breadth at

CANAL ZONE: Upper Río Pequini, Madden Lake area, vicinity of Police Station, *Fairchild & Jobbins 2639;* Quebrada Lopez, *Allen 2134.*

4. GEONOMA ALLENII Bailey, Gent. Herb. 6:204. 1943.

Very slender small palm to 2 m. tall: leaves pinnate, practically evenly gray-green, with blade 25–35 cm. long and concavo-convex petiole of similar length; pinnae 2 pairs and a terminal deeply bifid part, the bases broad at attachment to

rachis and not always precisely opposite, length about 20–25 cm., breadth at middle 3–4 cm., long-tapering rather abruptly into a narrow end and usually (as on apical lobes) into a thread-like cauda 5–7 cm. long, veins pronounced and about 4–5 mm. apart and elevated on upper face, glabrous on both surfaces: spadix a simple slender glabrous spike 10–14 cm. long subtended by a sessile bract (upper spathe-valve) that leaves a ring when it falls, the very slender erect peduncle about 50 cm. long with glabrous striate sheathing spathe-valve at base; rachilla or spike 2–3 mm. thick at fruiting time, alveoles distinct and separate in about 4 rows, the narrow nearly or quite entire lower lip divaricate and prominent: fruit oblong-pyriform, 10–11 mm. long, somewhat narrowed to base, nearly obtuse at apex, glabrous, somewhat pimpled.

Panama.

COCLÉ: hills north of El Valle de Antón, alt. 800 m., *Allen 2947*.

5. GEONOMA CONDENSATA Bailey, Gent. Herb. 6:206. 1943.

Tree or bush 1.6 m. tall: leaf-blade about 1 m. long, dull green, irregularly pinnate, glabrous both surfaces, lighter-colored underneath; pinnae about 2 pairs including the bilobed apical part, and a few intermediaries or shreds (as splits of pinnae) between, the separation between the two pairs being perhaps 10–12 cm. of rachis, the wide bases irregularly opposite; terminal part divided into long-acuminate lobes 40–50 cm. long and 4–6 cm. broad; each of the other pair 40–50 cm. long and 6–7 cm. broad; all pinnae and lobes very strongly many-ribbed, the main ribs whitish on under surface and 10–12 mm. apart with 2 or 3 thinner nerves between; petiole and rachis slender, glabrous, sharply ridged on upper surface: spadix a single simple spike 12–16 cm. long, borne on a flattened two-edged petiole-like peduncle 1 m. long; rachilla glabrous but granular, about 4 mm. thick; alveoles close together, broad rather than high before frutescence, the lips not prominently projecting: fruit oblong, 11–12 mm. long, only slightly contracted to base, obtuse at apex, glabrous, carrying the 6 enlarged nearly separate narrow floral envelopes with it when removed and leaving a chaffy cup of 3 projecting bracts.

Panama.

BOCAS DEL TORO: Isla Colón, vicinity of Chiriquí Lagoon, *von Wedel 2972*.

6. GEONOMA PROCUMBENS Wendl. ex Spruce, in Jour. Linn. Soc. Bot. 11:105. 1871.

Ordinarily seen as an acaulescent palm, the caudex rising little if at all above the ground, but sometimes making a leaning or inclined ringed trunk 2 m. tall and 7–8 cm. thick: leaves from apex of caudex, pinnate, glabrous, blade 1 m. or more long; petiole slender, smooth, often 1 m. long; pinnae about 24 pairs, mostly narrow but differing in width on the same leaf from 2 to 5 cm. except the terminal pair which may be 10 cm. or more broad, 40–50 cm. long, strongly nerved, base somewhat decurrent on the rachis, apex long-acuminate and prominently falcate: spadix a simple spike on a long slender erect peduncle from a lower axil, spathes bract-like on the peduncle, flowering part of the spike about 50 cm. long and

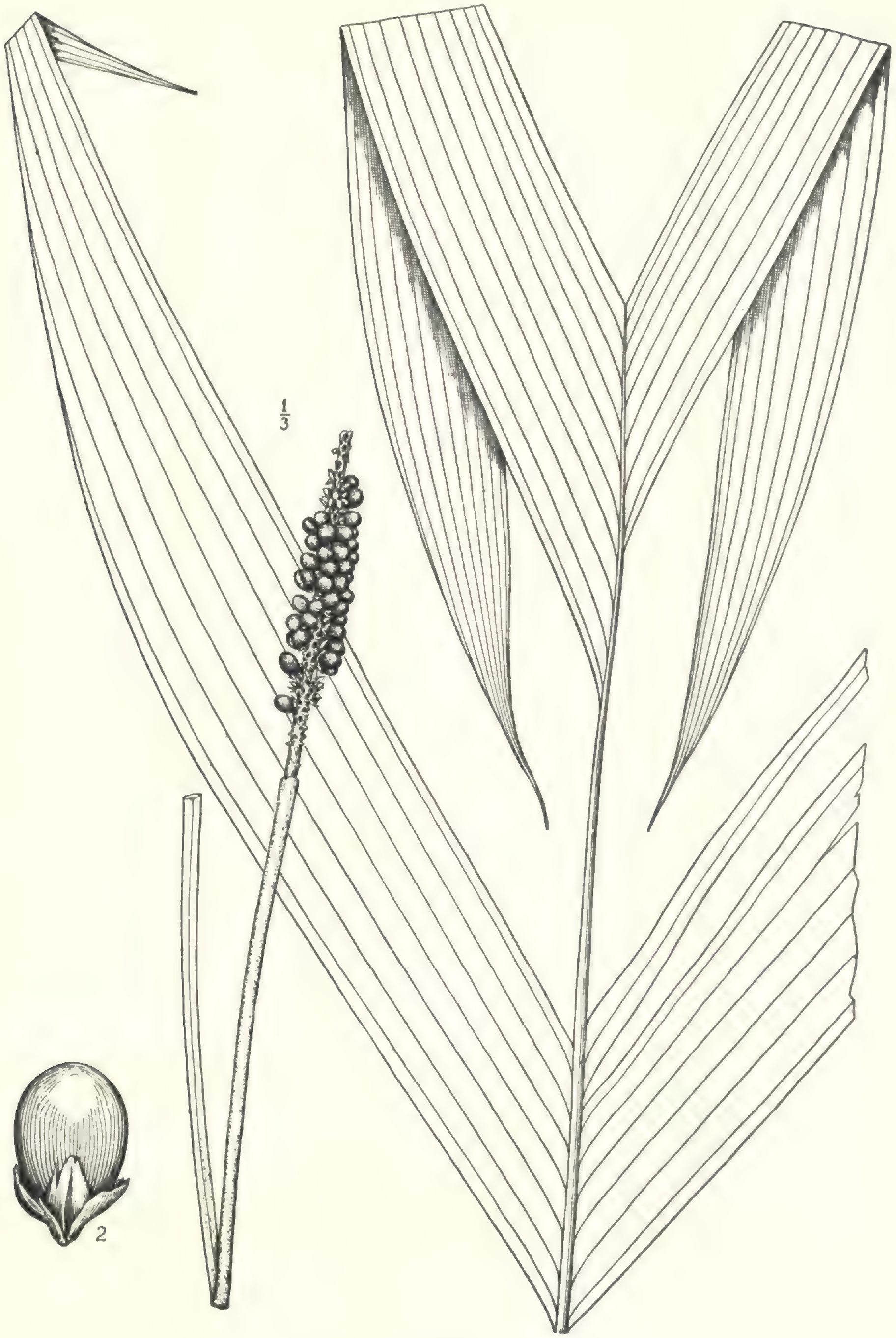

Fig. 65. *Geonoma condensata*

12–15 mm. thick, the flowers sunken in the rachilla in a closely packed sequence; staminate flowers whitish, soon perishing, the 6 anthers exserted, filaments connate in a tube; 3 white stigmas also exserted at anthesis: fruit at maturity 9–10–11 mm. long and about one-half as broad, ovoid-elliptic, pointed at either end, gray as if glaucous, very faintly striate, greenish on a dull red rachis; nutlet about 8 mm., albumen equable.

Panama, woods and gulches, probably generally distributed; Costa Rica.

CANAL ZONE: Barro Colorado Island; Quebrada Ancha, *Dodge & Steyermark 17065.* COCLÉ: north rim, El Valle de Antón, *Allen 1790, 2065.* BOCAS DEL TORO: vicinity of Chiriquí Lagoon, *von Wedel 2214.*

7. GEONOMA SIMPLICIFRONS Willd. in Mém. Acad. Sci. Berlin 1804:37.

Trunks several, 2–4 m. tall, flexuose, pale yellow or olive-gray, prominently ringed: mature leaves 1 m. or more long, oblong-lanceolate in outline, dull green with whitish nerves, deeply parted into 2 or 3 pairs of broad-based lanceolate or broad-lanceolate narrow-pointed lobes: peduncle 15–20 cm. long, at the apex bearing 3–6 or more terete sharp-pointed short erect or ascending rachillae 3–8 cm. long: fruit small, cherry-like, somewhat fleshy, acute at apex, dark violet.

In woods, southern Darién, *Seemann,* apparently not reported subsequently; a Venezuelan-Brazilian species, not listed among the palms of Colombia; it is doubtful whether it occurs in Republic of Panama.

8. GEONOMA CONGESTA Wendl. ex Spruce in Jour. Linn. Soc. Bot. 11:112. 1871.

Trunks or canes cespitose, 4–5 m. tall and 25 mm. thick, remotely annulate with rings 10–20 cm. apart: leaves about 2 m. long, dark green and shining, blade elongate-obovate, cuneate at base and deeply bifid at apex with very long-acuminate or thin caudate lobes sometimes irregularly pinnatisect with a few narrow lateral lobes close together, stiff or rigid in texture, with 50–60 strong lengthwise nerves either side and no definite midrib to the 2 broad terminal lobes: spadices short, issuing from ribbed cymbas 10–20 cm. long, that are short-acute or almost obtuse at the apex, peduncle 6–9 cm. long, branches 7–11, at first hanging but soon wide-spreading and sprawling, each branch about 10 cm. long and 6 mm. thick with the pointed divergent bracts conspicuous: fruit broad-ellipsoid, about 15 mm. long and 12 mm. thick, gray, surface drying rough; cupule small, the narrow acute parts nearly separte.

Panama, Costa Rica.

PANAMÁ: headwaters of Río Chinilla above Nuevo Limón, *Maxon 6903* (det. Burret).

9. GEONOMA FERRUGINEA Wendl. ex Spruce in Jour. Linn. Soc. Bot. 11:110. 1871; Burret, in Engler's Bot. Jahrb. 63:227. 1930.

Slender tree, with graceful arching pinnate very strongly veined leaves that are more or less brownish from minute pubescence or furfur; petiole 30–50 cm. long, flattish on under surface, ridged on upper face, more or less pubescent or thinly furfuraceous; blade 75 cm.–1 m. long, irregularly pinnate; pinnae well separated, many pairs but not definitely opposite, 30–40 cm. long, attached by broad bases, terminal pair 4–8 cm. broad, some of the others as narrow as 1 cm., conspicuously parallel-nerved with many light-colored ribs that stand 5–7 cm.

apart, apex narrowly long-acuminate: spathe-valves narrow, broad and essentially obtuse at end, brown-pubescent; spadix 18–30 cm. across either way at full expansion, brown-pubescent, rachillae simple from different sides of the rachis or sometimes once-forked, 8–12 cm. long, lower lip of alveole 2-fid but soon falling from some of the pits: fruit (immature) oblong, 8 mm. long but probably becoming 12 mm. or more long, surface roughened, cupule of narrow-lobed parts.

Panama, Costa Rica.

CHIRIQUÍ: rain forest, Bajo Chorro, Boquete District, *Davidson 377*.

Burret, in describing the plant from old collections in the Turrialba region of Costa Rica, says that this palm is 3–4 m. high; Davidson records it as 30–40 feet.

10. GEONOMA BINERVIA Oerst. in Kjoeb. Vidensk. Meddel. 1858:33. 1859.

Tree to 5 m. tall, trunk 4 cm. thick, strongly ringed: leaves unequally pinnate, blade to 2 m. long, petiole 30–60 cm. long; pinnae about 25 pairs, not uniform in width, glabrous or sometimes lightly scurfy on main veins, 50–60 cm. long, narrower ones not much more more than 1 cm. broad, others 7 or 8 cm. and terminal pair as much as 12 cm. or even more, all strongly parallel-veined, apex extended into narrow tails, obliquely attached and not narrowed on rachis: spadix compound and much branching, the long flattened peduncle subtended at base by 2 conspicuous upstanding ear-like strongly ribbed spathe-valves 15–20 cm. long; flowering and fruiting cluster 60–75 m. long, hanging, diffuse, the lightly pubescent maroon-colored rachillae 20–30 cm. long and 2–3 mm. thick, in which the minute purplish flowers are imbedded; staminate flowers about 4 mm. long, whitish, usually somewhat exserted at anthesis, filaments projected beyond the staminal tube, the 2 separated anther-cells pointed backward; pistillate flowers smaller, 3 stigmas exserted, staminodial tube pronounced: fruit globular-oblong, 4–6 mm. long, somewhat contracted toward base, glabrous, brown-black at maturity.

Fig. 66. *Geonoma binervia*

Panama, woods, often overlooked in underbrush, probably widely spread; Mexico to Costa Rica.

CANAL ZONE: Barro Colorado Island, *Bailey 76;* Canal Zone Forest Preserve, *Allen 2539;* Río Pequiní, Madden Lake area, *Fairchild & Jobbins 2637;* drowned forest of Quebrada Culebra, *Steyermark 17220.* PANAMÁ: Pedro Gonzales, Perlas Islands, Panama Bay, *Allen 2605.* BOCAS DEL TORO: Water Valley, *von Wedel 975.*

22. ASTEROGYNE Wendl.

ASTEROGYNE Wendl. ex Benth. & Hook. Gen. Pl. 3:914. 1883.

Small monoecious palms with simple somewhat lobed narrow leaves distin-

Fig. 67. *Asterogyne Martiana*

guished from *Geonoma* by the separate or discrete anthers pendulous from the top of the free part of the filament, disk adnate to the base of the corolla, style terminal, fruit ellipsoid; rachillae few, simple, placed finger-like at or near top of peduncle.

Species 2, Central America to Colombia.

1. ASTEROGYNE MARTIANA Wendl. ex Burret, in Engler's Bot. Jahrb. 63:140. 1930.
Geonoma Martiana Wendl. in Linnaea 28:342. 1856.

Shrub to 2 or 2.5 m. tall, erect, with thin costate foliage: leaf-blades simple and deeply bilobed or irregularly split-pinnate, 50–60 cm. long, 15–20 cm. broad, glabrous on upper face, somewhat brown-scurfy on rachis and ribs underneath, with many prominent nerves 5–6 mm. apart and 2 or 3 thinner ones between; pinnae (when the blade is divided) perhaps reduced to shreds as narrow as 1 cm., apices long-acuminate; petiole about 50 cm. long, very slender, furrowed or concave on under surface, ridged on upper surface, glabrous or perhaps temporarily scurfy: spadix a terminal almost umbelliform cluster of 4–6 finger-like straight or curved colored rachillae 10–12 cm. long and each bearing a nude spike at the end 1–1.5 cm. long; peduncle about 40 cm. long, erect, covered to one-half or more its length with 2 striate spathe-sheaths and very small bracts higher up; axis of rachilla 4–5 mm. thick at anthesis, closely pubescent, the flowers prominently projecting from the narrow alveoles; lower lip of alveole entire or only lightly emarginate, not reflexing; floral parts conspicuous at anthesis, the filament tube evident and the discrete anther-cells pendent in an inverted V-form from the top of the filament.

BOCAS DEL TORO: Water Valley, *von Wedel 952;* vicinity of Chiriquí Lagoon, *von Wedel 1108, 2186.*

Prominently distinguished by the narrow spiniform tip of the finger-like rachillae. This species was based originally on plants cultivated in Germany from Central America. It is reported from Nicaragua (as *Geonoma trifurcata* Oerst.), Costa Rica, Colombia, but not heretofore from Panama, the *Asterogyne* formerly assigned to Barro Colorado Island being *Geonoma decurrens.*

23. IRIARTEA Ruiz & Pav.

IRIARTEA Ruiz & Pav. Fl. Peruv. & Chil. Prodr. 149. 1794.

Tall erect slender unarmed monoecious pinnate-leaved palms with conspicuous brace-roots, notable crownshaft and often with bulged trunk: pinnae irregular, often split so that several of them appear to stand together on the rachis, usually broadened towards the apex and variously lobed or notched or erose at summit: spadices infrafoliar, below the prominent crownshaft, inclosed at first in papery cymbas: flowers typically in 3's on the simple rachillae (which are side-branches from the axis of the spadix), central flower pistillate and the laterals staminate but

this disposition may not apply uniformly and a rachilla may be pistillate mostly on its lower part and staminate on the upper part; stamens usually fewer than 20, about equal in length to the broad envelopes, anthers long and filaments very short; pistillate flowers smaller than staminate; ovary 3-loculed, stigmas small, staminodia sometimes present: fruit subglobular, oblong or ovoid, 1- to 2-seeded; albumen homogeneous, embryo lateral or dorsal.

About a half dozen species in South America, one of them reaching eastern Panama. *Iriartea* and *Socratea* are distinguished mainly by technical characters: *Iriartea,* spathes many, stamens commonly less than 20 and as few as 9 or 10, embryo dorsal or lateral; *Socratea,* spathes cymba-like, stamens commonly more than 20, usually 25–35, embryo subapical.

1. IRIARTEA CORNETO (Karst.) Wendl. in Bonplandia 8:102. 1860.
Deckeria Corneto Karst. Fl. Columb. 107. 1856.

Very tall palm overtopping the forest, reported as much as 60 m., trunk about 30 cm. diameter, often tumid at middle, obscurely ringed, brace-roots many and conspicuous: leaves about a dozen, forming a compact high head or coma, the irregular cuneate pinnae about 20 pairs and split or parted into several parts 1 m. long and 13–15 cm. broad, some of them narrower, erose at summit: spadices hanging, with short rachillae issuing from the rachis; staminate flowers mostly twin on upper part of rachilla, pistillates solitary at base of rachilla or single between 2 staminates; stamens 16–20, pistillode missing; petals valvate; pistillate flowers with imbricate or convolute petals, 3-loculed ovary: fruit depressed-globose, 5 cm. thick, somewhat succulent, yellowish-orange; seed solitary.

DARIÉN: in mixed hardwoods, in hills chiefly, between 4000 and 5000 feet altitude.

Described originally from humid forests in the Andes of Bogota, and known eastward on the llanos. The Darién occurrence needs further study. Called *Corneto.*

24. SOCRATEA Karst.

SOCRATEA Karst. in Linnaea 28:263. 1856.

Erect tall pinnate-leaved monoecious palms with strong brace-roots near the base of the obscurely ringed trunk, unarmed except that the brace-roots may bear spinous processes, the pinnae unequal in size and shape and variously erose or notched or jagged at apex, crownshaft prominent and more or less bulged at apex of bole and underneath the canopy of leaf-blades: spadices infrafoliar, once-branched, eventually drooping or hanging; cymbas 2, thin and papery when dry, the spadix itself usually bractless; pistillate flowers either near the base of the rachilla or the length of it among the staminate flowers, normally 1 between 2 staminates; stamens many, about equalling the valvate petals, sepals very small, pistillode minute or none; pistillate flowers with imbricate small sepals; staminodia lacking; ovary 3-loculed: fruit drupe-like but with firm or hard exterior, ellipsoid

or obovoid or oblong, size of small plum, 1- to 2-seeded; albumen equable, embryo subapical.

Eight or ten species, South American and one of them extending northward to Nicaragua.

1. SOCRATEA DURISSIMA (Oerst.) Wendl. in Bonplandia 8:103. 1860.
Iriartea durissima Oerst. in Kjoeb. Vidensk. Meddel. 1858:30. 1859.

Slender forest tree to 25 or 30 m., often swaying or leaning but essentially an erect palm, trunk irregularly but prominently ringed, petioles deciduous: leaf-blade to 2 m. long, with many irregular rather narrow pinnae and a pair of very broad terminal ones, glabrous except perhaps furfuraceous on under surface near base; pinnae 40–60 cm. long, variable in width from 4 to 20 cm., broader toward apex and irregularly notched at end and perhaps along the side, terminal ones sometimes nearly truncate, all very strongly several-nerved: cymbas 40–50 cm. long, not sulcate, deciduous; staminate flowers 10–12 mm. long; sepals obtuse; petals broad-ovate, large; stamens about 35, nearly as long as petals, anthers long and filaments very short; pistillate flowers smaller than staminates, sepals and petals imbricate, pistil 3-loculed: fruit oblong, 2.5–3 cm. long, obtuse but with short oblique point, becoming dull brown; seed single, with very hard white albumen.

Frequent tree in Canal Zone; probably widely distributed in Panama. Sometimes the brace-roots are many and as high as a man, and the main trunk may nearly disappear close to the ground. Known as *Stilt Palm, Jira.*

CANAL ZONE: Barro Colorado Island, *Bailey 74.* COLÓN: Quebrada Lopez, slopes of Cerro Santa Rita, *Allen 2942.*

Identification of this palm is not positive. S. *durissima* was described from the San Juan River region in Nicaragua without flowers or fruits. When good collections are made in that territory the relationship to the Panama tree can be determined.

25. MALORTIEA Wendl.

MALORTIEA Wendl. in Berliner Allgem. Gartenzeit. 21:25, 145. 1853; Hook. f. in Benth. & Hook. Gen. Pl. 3:906. 1883.

Small often nearly or quite acaulescent spineless glabrous monoecious palms with unequally or imperfectly pinnate or pinnatisect dentate leaves or the blade sometimes simple and lobed, parts broadest toward the top and not attenuate-pointed: spadices interfoliar, consisting of 2–4 very short rachillae that bear both staminate and pistillate flowers in the axil of a short bract or lip; stamens 9 or more, within angled striate floral envelopes; ovary more or less 3-loculed; staminodia usually present: fruit oblong or ellipsoid, small, not fleshy, obtuse or umbonate, 1-seeded; albumen plain, flinty.

About a half dozen species in forests and shady moist places, Mexico to Panama; generic limits not yet well understood.

Fig. 68. *Malortiea simplex*

1. MALORTIEA SIMPLEX Wendl. in Bot. Zeit. 17:5. 1859.
Reinhardtia simplex Burret, in Notizbl. Bot. Gart. u. Mus. Berlin 11:554. 1932.

Erect, 1 m. or less tall, often only 50 cm., sometimes reported much larger, with few erect lobed or irregularly pinnate or pinnatisect leaves, the blade 15–25 cm. long and 9–10 cm. broad, central lobe or part much larger than the 2–4 very narrow lower divisions and oblong or cuneate-oblong in outline, margins incised or strongly dentate or both, midrib prominent and lateral ascending veins issuing from it; petiole thin, flattened: peduncle from lower axils near the ground, 15–30 cm. long, flattened, rachilla at the top 4–7 cm. long: fruit oblong, 12–14 mm. long, about 6 mm. wide, black, blunt or short-acute.

Panama; originally described from Costa Rica.

BOCAS DEL TORO: Water Valley and Chiriquí Lagoon, *von Wedel 611, 923, 1002, 1592.* DARIÉN: forests around Pinogana, southern Darién, *Pittier 6539.* "Rubber station in western Panama," *Stork 116.*

26. RAPHIA Beauv.

RAPHIA Beauv. Fl. Oware et Benin 1:75. 1804.

Monoecious unarmed pinnate-leaved heavy trees, often soboliferous or growing in clumps in moist or wet places, monocarpic (plant dying after fruiting): spadices immense in size, interfoliar; the great branches pendent or hanging, 2 m. and more long, thicker than a man's arm, the ultimate stiff or even rigid distichous rachillae 6–10 cm. long and very closely flowered, the long staminate flowers conspicuously imbedded, stamens 6 and more with erect linear anthers; pistillate flowers larger or at least broader than the staminate, ovoid, the closed body or involucre covered with retrorse scales, staminodia present inside, ovary 3-loculed, stigma sessile; trusses or "hands" of flowers and fruits projecting from beneath hard parchment-like sheathing imbricate scales or spathes that immutably involve the rachis: fruit a loricate oblong or pyriform body 4–6 cm. long, containing within the shell a single oblong nut-like seed ornamented with rapheal lines and depressions and ruminate inside with prominent intrusions.

About 20 species in tropical Africa, and several varieties; the only Old World genus of palms native also in the western hemisphere, represented on the continent by apparently a single species; another species on Martinique, French West Indies, is perhaps introduced.

1. RAPHIA TAEDIGERA Mart. Hist. Nat. Palm. 3:216. 1838.
Sagus taedigera Mart. op. cit. 2:54. 1824.
Raphia vinifera var. *taedigera* Drude, in Mart. Fl. Bras. 3^2:287. 1882.
Raphia vinifera Auth., non Beauv.

Soboliferous, making a mass of great ascending and arching leaves and trunks arising from the mass 8–9 m. or more and as much as 30 cm. thick, sending up slender breathing-roots or shoots a few cm. above the mold or the water: leaves uniformly pinnate, 12–14 m. long; petiole 15–20 cm. thick near its base, convex

on under surface and concave on upper face, woody; pinnae numerous and close together, subopposite, 1–1.5 m. or more long, 4–5 cm. broad, midrib prominent and elevated with strong secondary veins either side, apex long-pointed but not very narrow, margins bearing thin forward-pointing spicules: flowers in clusters protruding in distichous hands or clusters from the tight spathes or sheaths, at fruiting time the spent staminiferous fingers conspicuous among and beyond the fruits and spathes: fruit short-oblong with nearly square or truncate ends and short beak, 5–7 cm. long and 3–4 cm. thick, completely covered by smooth brown imbricate lorics or scales with scarious margins and indistinct median line; inside the loricate shell another integument incloses an oblong hard wrinkled nutlet or seed about 3 cm. long, the albumen coarsely ruminate.

CANAL ZONE: Mohinga Swamp, lower Chagres River, *Bailey 578.* BOCAS DEL TORO: near Almirante, *A. F. Skutch.*

Called *Pine-cone Palm.* Probably generally distributed along the Atlantic seaboard; supposed to be the same species as that in the estuary region of the Amazon, whence the species *taedigera* was first described; there are indications that it grows near Puerto Limón in Costa Rica. Material is not available for determination of *R. nicaraguensis* Oerst., of Nicaragua; Beccari thinks it to be the African *R. Ruffia* Mart.

27. MANICARIA Gaertn.

MANICARIA Gaertn. Fruct. et Semin. Pl. 2:468. 1791.

Vigorous medium-sized monoecious unarmed trees with pinnately veined large leaves that are variously indented and pinnatisect or even pinnate, inflorescence interfoliar, trunk roughly ringed: spadix 1 m. long more or less, inclosed in a papery closed woven bag that tears open irregularly lengthwise to free the densely flowered rachillae; staminate flowers occupying upper part of rachilla somewhat sunken in it and attended by subulate bracts, stamens many (commonly 27) with linear erect anthers; pistillate flowers mostly near base of rachilla, somewhat immersed, 3-loculed and 3-ovuled, one or more of the ovules developing, staminodia perhaps a dozen: fruit an echinate or tubercled hard large cortex, a nearly globular ball when one ovule develops but often 2- to 3-lobed; seed globular, reticulated with rapheal branches, embryo basal, albumen plane.

Three species in farther West Indies, Central America, South America.

1. MANICARIA SACCIFERA Gaertn. op. cit. 469. 1791.

Tree to 10 m., usually growing in colonies, trunks to 30 cm. diameter and two of them often coalesced at base and commonly inclined or leaning, with aerial roots at base: leaves inclined and finally lopped or hanging, to 10 m. long and 2 m. broad, the blade nearly entire to rather completely but very irregularly pinnate, texture coriaceous, glabrous; pinnae or segments 2 cm. or much more broad with strong midrib and indifferent parallel veins, 1 m. more or less long, not much narrowed and obliquely attached at base; petiole 1 m. or more long, soft and

light, not woody: spadix a simple continuing axis, the rachillae simple and 25–30 cm. long: fruit when simple or 1-seeded essentially globular but somewhat tapered to base, 4–5 cm. diameter, when twin or triplet 7–8 cm. the long way, brown when dry, completely covered with angular tubercles.

Wet places, as on or near shores and in swamps, Atlantic side of Panama, often in dense groves, probably widely distributed in the Republic; the one growing in Central America and southern West Indies is apparently this species. The hard durable nuts often are carried long distances by sea, the rough exterior perhaps perishing on the way and only the polished interior shell externally remaining. Called *Monkey-cap Palm*, because from the brown sleeve or cloth-like spathe caps are made which are sold on the streets of Colón.

CANAL ZONE: swamps near Fort Sherman, Bay of Limón, *Bailey 214*.

28. PHYTELEPHAS Ruiz & Pav. "Ivory-nut Palm"

PHYTELEPHAS Ruiz & Pav. Syst. Veg. 299. 1798.
Elephantusia Willd. Sp. Pl. 4:1156. 1805.

Dioecious pinnate-leaved mostly heavy palms with trunks inclined or more or less creeping at first and bearing roots, spadices infrafoliar, borne near or at the surface of the ground, fragrant in bloom, frequently in colonies and often almost to the exclusion of other vegetation, sometimes in clumps or "islas," staminate tree usually larger and more robust: leaves very long, ascending-arching with many alternate and subopposite long narrow pinnae: staminate spadix a long compactly flowered simple and often recurved catkin with its short peduncle inclosed in 2 cymba-like spathe-valves above which there may be pointed bracts on the peduncle, the individual flowers with a simple toothed perianth and many stamens bearing anthers mostly shorter than the filaments; pistillate spadix a head or heads of several flowers at the summit of a stout peduncle with 3 or 4 spathes, bearing a few long flowers with many slender staminodes about the 6- to 9-loculed prominent ovary from the center of which arises an extended style with 6–9 spreading or recurved stigmas at its apex; floral envelopes imbricate, sepals 3, petals 6 or more, and a few long white or whitish bracts exceeding the petals; each locule of the ovary containing a single erect ovule attached to a central intrusion or placenta: fruit a flattened tuberculate body 12 cm. and more across and 7–10 cm. high containing within the brittle shell as many nutlets as there were locules in the ovary, the place of the styles in the center of the head being covered by large inflexed tubercle-like points; nutlets hard and heavy, wedge-shaped with thin edge toward the center and the back obtuse or rounded, surface covered with loose fibers; seed inside the firm shell of the nutlet, of its same general conformation, sometimes covered with rapheal ridges and markings but in other species smooth, embryo at the lower inner angle or corner near the hilum imbedded in very hard continuous ivory-like white plane albumen. (Morphologies subject to modification as new studies develop.)

Fig. 69. *Phytelephas Seemannii*

Panama to Peru in damp places in valleys of streams, coastal areas and sometimes on mountains of 1000 m.; species perhaps a half dozen but not well understood, and accurate definitions yet impossible because of lack of type and authentic specimens. There appears to be much variation in the period at which the trunk assumes an upright direction and in the height it eventually attains, as well also as in the size and shape of the seeds. At first the interior of the seed is liquid or of a jelly-like consistency, but it eventually becomes exceedingly dense and hard and the albumen is used in industry as "vegetable ivory" for the making of buttons, cane-heads and other small articles and the seeds are an article of exportation from their native regions. The great heads with angular spines and tubercles, often weighing several pounds, are striking-looking objects, earth-brown, glabrous, the processes usually strongly striate.

1. PHYTELEPHAS SEEMANNII Cook, in U. S. Dept. Agr., Bur. Plant Ind. Bull. 242:68. 1912; Jour. Washington Acad. Sci. 17:226. 1927.

Phytelephas macrocarpa Seem. Bot. Voy. Herald, 205. 1852; not Ruiz & Pav., as to the Panama plant.

Trunk at first decumbent or creeping, at length rising under favorable conditions and age, becoming 40 cm. or more thick and perhaps 8 m. tall, bearing at one time about 20 living leaves; bases of the petioles persistent on the short trunk and accumulating dirt and refuse among which the great fruits may rest: leaves 2 m. and more long, mostly rising from near the ground; petiole trough-like, deeply concave on front, keeled on back, not hard-woody; pinnae 100 and more, 5–6 cm. apart on the ridged rachis or more remote on the lower part of the blade, central ones about 1 m. long and 3–5 cm. broad, with pronounced midrib and strong side-ribs, conspicuously irregularly cross-veined particularly underneath, tending to split lengthwise: staminate spadix often 1 m. or more long, sometimes much less: fruiting clusters usually 2–5 in number, each cluster comprising 3–8 depressed fruits or heads on a short stout peduncle and armored like an alligator's hide, the clusters at maturity often lying on the ground or in the mold caught in the leaf-bases; nutlets 9 or fewer in each fruit, about 7 cm. high, 6 cm. broad, 3–4 cm. thick at the rounded back, inner side (against its neighbor) flat, becoming coal-black, involved in coarse fibers, free inside the carpellary tubercled shell; seed free inside the hard but rather thin integument, semi-lunate, about 5 cm. high and 4 cm. broad, ridged and ornamented with rapheal subsidiaries, albumen ivory-like and white.

Apparently widely distributed in Panama but its range elsewhere, if any, not determined.

COLÓN: slopes of Cerro Santa Rita, *Allen 2941*. DARIÉN: "banks of rivers of Southern Darién, forming extensive groves by itself," as stated by Seemann.

Seemann writes that in December, 1847, "whilst ascending the river Cupica, I had the good fortune to fall in with the Ivory plant, and afterwards met with it in various other parts of Darién." Cook states that "the original locality of Seemann's palm at Cupica is not in Panama territory."

It is probable that the names *P. brachelus, brachinus, brevipes, cornutus, Pittieri* O. F. Cook, 1913, come within *P. Seemannii* as here defined, and they are not at present separately treated; the collections were made at Garachiné, San Miguel Bay, near the south coast of Panama; Gasapasabana, Upper Mamoni River; Río Fató Valley, near Nombre de Dios; Puerto Obaldía. The descriptions are not sufficient and specimens of mature fruits are not in the National Herbarium, although photographs of some of them are available.

CYCLANTHACEAE

Perennial shrubs or suffrutescent herbs of Palm-like habit, acaulescent or with more or less extensive, frequently clambering stems, terrestrial or epiphytic. Leaves spiral or distichous, 2-cleft or flabellate, rarely entire. Inflorescence a spadix of small monoecious flowers, subtended by 2 to several conspicuous foliaceous or petalaceous spathes. Staminate and pistillate flowers alternating spirally or arranged in alternate cycles. Staminate flowers: perianth 0 or cupulate and several-toothed; stamens numerous, anthers 2-celled, longitudinally dehiscent. Pistillate flowers: 2- to 4-carpellate, separate or mutually concrescent; perianth 0 or of 4 perigonial lobes; staminodes 4–6, filamentous and usually very long and filamentous; ovary superior to inferior, 1-locular, bearing numerous anatropous ovules upon 2–4 parietal placentae, stigmas 1–4. Fruit a fleshy syncarp of distinct or united berries, frequently shed from the spadix in concrescent sheets of fleshy pulp.

a. Staminate and pistillate flowers alternating spirally, the staminate in clusters of 4, the pistillate solitary; plants not laticiferous ..... 1. CARLUDOVICA
aa. Staminate and pistillate flowers arranged in separate, alternating cycles, the pistillate of each cycle strongly concrescent; plants laticiferous..... 2. CYCLANTHUS

1. CARLUDOVICA R. & P.

CARLUDOVICA R. & P. Fl. Peruv. Prodr. 136. *pl. 31*. 1797.
Ludovia Pers. Syn. 2:576. 1807.
Salmia Willd. Ges. Naturf. Fr. Berlin, Mag. 5:399. 1811.
Ludovia Brongn. Ann. Sci. Nat. XV, 4:361. 1861, non Pers.
Evodianthus Oerst. Kjoeb. Vidensk. Meddel. 194. 1875.
Sarcinanthus Oerst. loc. cit. 196. 1875.
Steleostylis Drude, in Mart. Fl. Bras. 3^2:230. 1881.

Plants acaulescent or with more or less extensive, erect or clambering stems, terrestrial or epiphytic. Leaves spiral or distichous, 2-cleft or divided into 3 to many flabellate divisions, rarely entire. Spadix subtended by 2 to several green or white spathes. Staminate and pistillate flowers alternating spirally, the staminate in clusters of 4, the pistillate solitary. Staminate flowers with many-toothed, cupulate perianth, caducous or marcescent. Pistillate flowers separate or mutually sunken in the fleshy spadix axis, with 4 equal or subequal, free or basally united, more or less conspicuous perigonial lobes; stigmas 4, sessile or with a short style. Berries produced separately or in concrescent sheets of fleshy tissue.

The various segregate genera of *Carludovica* are based for the most part upon rather obscure characters of the staminate flowers such as a plane or concave surface of the receptacle, distribution of the stamens, texture and even coloration of the staminal filaments, and attachment of the pedicel. Since these criteria are so infrequently or so poorly observable in the rather meager herbarium material available at present, and in view of the obviously close relationship of the plants, "it seems better to keep them all in *Carludovica* as sections, where they are just as valuable or more so in our present lack of knowledge" [Gleason, Bull. Torrey Club 56:2. 1929].

The Carludovicas include over 30 recognizable species of tropical America, both continental and Antillean, where they form a conspicuous element of the rain forest vegetation from sea level to altitudes of over 2500 m.

a. Leaves entire, or but slightly crenulate toward the subcaudate tip ..... 1. C. INTEGRIFOLIA
aa. Leaves deeply bifid or flabellate.
b. Leaf blade much longer than broad, deeply bifid, or irregularly lacerate in age.
c. Spathes congested immediately below the spadix; fruiting flowers nearly separate.
d. Spadices oblongoid or cylindrical; anthers exserted.
e. Plants large and coarse, usually with rather stout, clambering stems; fruiting spadices about 2.0–2.5 cm. long ..... 2. C. UTILIS
ee. Plants small and slender, acaulescent or nearly so; fruiting spadices about 1 cm. long ..... 3. C. MICROCEPHALA
dd. Spadices globose, about 2 cm. in diameter; anthers included; plants of moderate size, with relatively slender, clambering stems ..... 4. C. OERSTEDII
cc. Spathes more distant, extending along about the upper half, or the entire length of the peduncle; fruiting flowers more or less immersed within the fleshy spadix axis.
d. Leaf segments broadly ovate or ovate-trigonal, abruptly acute to very shortly acuminate; spadices globose ..... 5. C. PITTIERI
dd. Leaf segments lanceolate to linear-lanceolate, gradually acuminate; spadices oblongoid to cylindrical.
e. Spathes persistent in fruit; plants relatively slender, the stems clambering, the leaf sheaths about half encircling the stem ..... 6. C. MICROPHYLLA
ee. Spathes deciduous; plants stout, the leaf sheaths encircling the stem.
f. Spadices 2–3 times as long as broad, much thicker than the peduncle; primary nerves of leaves relatively close (0.3–0.6 cm.).
g. Plants acaulescent or with short stout stems; fruiting spadices 1–3 cm. broad; spathes borne along the upper half of the peduncle; stigmas with short but obvious styles ..... 7. C. ENSIFORMIS
gg. Plants with extensive clambering stems; fruiting spadices 4–5 cm. broad; spathes borne along the whole length of the peduncle; stigmas sessile ..... 8. C. SARMENTOSA
ff. Spadices 5–8 times as long as broad, scarcely thicker than the peduncle; primary nerves of leaves relatively distant (1.0–2.5 cm.) ..... 9. C. KILLIPII
bb. Leaf blade as broad as long, usually deeply divided into 3–5 wedge-shaped segments, these in turn subdivided into numerous acuminate, flabellate sectors.
c. Fruiting perigonial lobes scarcely laminate, about as long as the stigmas or somewhat shorter ..... 10. C. PALMATA
cc. Fruiting perigonial lobes distinctly laminate, much longer than the stigmas.

d. Fruiting perigonial lobes very narrowly lanceolate-trigonal, 0.7–0.8 cm. long ..... 11. C. DRUDEI
dd. Fruiting perigonial lobes broadly oblong-trigonal, 2.5–3.0 cm. long ..... 12. C. ROTUNDIFOLIA

1. CARLUDOVICA INTEGRIFOLIA Woods. in Woodson & Schery, Ann. Missouri Bot. Gard. 29:322. 1942.

Plants apparently rather graceful and clambering. Leaves rather long-petiolate, membranaceous, entire, broadly elliptic-oblanceolate, broadly acute and slightly crenulate toward the tip, apex narrowly and abruptly subcaudate-acuminate, the base acute, gradually tapered from about the upper third, 22–30 cm. long, 4–6 cm. broad; petioles rather slender, 12–15 cm. long, vaginate for the lower third. Peduncles 5–6 cm. long, rather slender. Spadix (in immature fruit) fusiform-cylindric, about 2.0–2.5 cm. long, about 0.4 cm. thick; pistillate flowers small, sessile, perigonial lobes very shallow, scarcely manifest. Spathes deciduous, apparently 5, borne along the upper half of the peduncle.

Panama.

DARIÉN: Río Sambú, above tide level, *Pittier 5560.*

Another entire-leaved Carludovica was collected by P. C. Standley in the garden of C. W. Powell at Balboa, C. Z., in 1925. The specimen (U. S. Nat. Herb. no. 1252076) consists of a single leaf of the same general outline as those of *C. integrifolia* but much larger (about 50 cm. long, 12 cm. broad), and is accompanied by the following remarks: "Said to be from the nearby woods. Acaulescent. Leaves all simple." No similar plants have been encountered in the Canal Zone since that time, and the cultivated plant apparently was lost before the Missouri Botanical Garden acquired Mr. Powell's collection in 1926.

2. CARLUDOVICA UTILIS (Oerst.) Benth. & Hook. ex Hemsl. Biol. Centr.-Am. Bot. 3:416. 1885.

Sarcinanthus utilis Oerst. Vid. Medd. Kjoeb. 197. 1857.

Plants stout, usually clambering; stems 1.5–2.5 cm. thick. Leaves long-petiolate; blades 50–70 cm. long, bifid for about ⅔ their length, the segments narrowly lanceolate, gradually acuminate, 3–5 cm. broad; petioles 40–60 cm. long, relatively stout and clasping at the base. Peduncles relatively slender, about 10 cm. long in flower, increasing to about 20 cm. in fruit; spathes congested immediately subtending the spadix, 4–6, ovate-lanceolate, acuminate, 5–7 cm. long, deciduous; spadix oblongoid, 2.0–2.5 cm. long, about 0.8 cm. thick.

British Honduras to Panama; possibly extending to Colombia.

CANAL ZONE: Quebrada Ancha, *Steyermark & Allen s. n.*; Quebrada Salamanca, *Dodge, Steyermark & Allen 17005;* Quebrada Bonita, *Dodge & Allen 17075.* DARIÉN: Cana-Cuasi Trail, Chepigana Distr., *Terry & Terry 1466.*

Popular names in Costa Rica applied to this plant are reported by Standley as *Coligallo, Cola de gallo, Tucuso, Palma,* and *Chidra.* The dried and blanched leaves have been employed locally in the manufacture of hats, and the stems of this and other species of the genus are used like willow stems in the building of furniture and baskets.

3. CARLUDOVICA MICROCEPHALA Hook. f. Bot. Mag. *pl. 7263.* 1892.

Plants slender, acaulescent or nearly so; stems about 0.7 cm. thick. Leaves fairly long-petiolate; blades 15–20 cm. long, bifid for about ⅔ their length, the segments ensiform, narrowly acuminate, 2.0–2.5 cm. broad; petioles 14–18 cm. long, slender. Peduncles very slender, 3.5–4.0 cm. long in flower, increasing to 10 cm. in fruit; spathes 2, congested immediately below the spadix, ovate, narrowly acuminate, 2.5 cm. long, pale green; spadix oblongoid, about 1 cm. long, 0.5 cm. thick.

Greater Antilles; Honduras to Panama, in lowland forests.

BOCAS DEL TORO: Isla Colón, *von Wedel 1259;* Water Valley, *von Wedel 921;* hills above Fish Creek, *von Wedel 2188.*

4. CARLUDOVICA OERSTEDII Hemsl. Biol. Centr.-Am. Bot. 3:416. 1885.

Evodianthus angustifolius Oerst. Vid. Medd. Kjoeb. 195. 1857, non *C. angustifolia* R. & P.

Plants of moderate size; stems clambering, rather slender, about 1 cm. thick. Leaves rather shortly petiolate; blades 45–50 cm. long, bifid for about ⅔ their length, the segments linear-ensiform, very narrowly acuminate, 1.5–2.5 cm. broad; petioles 12–15 cm. long. Peduncles 7–9 cm. long in fruit; spathes 2–3, congested immediately below the spadix, deciduous; spadix globose, about 2 cm. in fruit.

Honduras to Panama, in lowland forests.

BOCAS DEL TORO: Isla Colón, *Woodson, Allen & Seibert 1943; von Wedel 479, 2975, 281;* Water Valley, *von Wedel 824.* SAN BLAS: Plain of Sperdí, near Puerto Obaldía, *Pittier 4352.*

Popular names in Costa Rica, according to Standley, are *Coligallo, Chirrivaca,* and *Chidra.* Oersted reported that Indians had been seen to eat the ripe spadices.

5. CARLUDOVICA PITTIERI Woods. in Woodson & Schery, Ann. Missouri Bot. Gard. 29:323. 1942.

Plants of moderate size, acaulescent or nearly so. Leaves long-petiolate; blades about 28 cm. long and 15 cm. broad, bifid for only about ¼ their length, the segments 7 cm. broad, broadly acute to very shortly acuminate; petioles relatively slender, 19 cm. long. Peduncle 5 cm. long in fruit, bearing 2 distinct spathe-nodes at about the middle; spathes deciduous; fruiting spadix globose, 2.0–2.5 cm. in diameter.

Panama, in foothill forests.

SAN BLAS: high hills back of Puerto Obaldía, *Pittier 4312.*

6. CARLUDOVICA MICROPHYLLA Oerst. Vid. Medd. Kjoeb. 197. 1857.

Carludovica stenophylla Standl. Fl. Costa Rica 3:130. 1937.

Plants relatively slender; stems extensive and clambering, about 0.5 cm. thick. Leaves rather shortly petiolate; blades 20–60 cm. long, bifid for about ⅔ their length, the segments rather broadly ensiform, narrowly acuminate, about 2 cm. broad; petioles 8–35 cm. long, very slender, the base about half encircling the stem. Peduncles 9–10 cm. long in flower and fruit; spathes 6–8, persistent, borne

Fig. 70
Carludovica microphylla

the entire length of the peduncle, ovate to ovate-lanceolate, acute to acuminate, 5–8 cm. long, pale greenish; spadix broadly oblongoid, 3.5–4.0 cm. long, 1.5–2.0 cm. thick.

Costa Rica and Panama, in highland forest.

CHIRIQUÍ: Bajo Chorro, *Davidson 34, 376;* Río Chiriquí Viejo valley, *G. White 75;* Bajo Mona and Quebrada Chiquero, *Woodson & Schery 567;* Bambito to Cerro Punta, *Allen 306.*

Very frequent in mountain forests of the Cordillera de Talamanca. The outstanding characteristic of this species is the persistent spathes, by which it may be instantly recognized.

7. CARLUDOVICA ENSIFORMIS Hook. f. Bot. Mag. *pl. 6418.* 1879.

Carludovica irazuensis Cuf. Archivio Bot. 9:4. 1933.

Plants acaulescent or with a rather short, stout stem. Leaves with long or relatively short petioles; blades 30–70 cm. long, bifid for about ¾ their length, the segments ensiform, gradually acuminate, 2–6 cm. broad; petioles relatively stout, 15–50 cm. long, broadly sheathing at the base. Peduncles 8–17 cm. long in fruit; spathes numerous, caducous, borne along about the upper half of the peduncle; fruiting spadix oblongoid, 3–9 cm. long, 1–3 cm. thick; fruiting perigonial lobes broadly ovate-trigonal, about equalling the pistils; stigmas with short but manifest styles.

Costa Rica and Panama, in highland forests.

CHIRIQUÍ: Cuesta de Las Palmas, Cerro de la Horqueta, *Pittier 3240;* Volcán de Chiriquí, *Woodson, Allen & Seibert 878;* Bajo Chorro, *Woodson & Schery 625; Davidson 35;* Cerro Copete, *Woodson & Schery 373;* Cerro Punta to headwaters of Río Caldera, *Allen 1460.* COCLÉ: El Valle de Antón, *Woodson & Schery 192.*

8. CARLUDOVICA SARMENTOSA Sagot ex Drude, in Mart. Fl. Bras. 3^2:239. *pl. 58.* 1881.

Plants stout; stems extensive and clambering, 1.0–2.5 cm. thick. Leaves very shortly petiolate; blades 20–30 cm. long, bifid for about ¾ their length, the segments about 2 cm. broad, narrowly acuminate; petioles relatively slender, 7–9 cm. long. Fruiting peduncles about 10 cm. long, very stout; spathes numerous, caducous, borne the whole length of the peduncle; fruiting spadices very broadly oblongoid or ovoid, 7–8 cm. long, 4–5 cm. thick; fruiting flowers very large,

about 1.0–1.5 cm. broad, the perigonial lobes broadly deltoid, about equalling the pistils, the stigmas sessile.

Panama, Colombia, and the Guianas, in highland forests.

DARIÉN: Cana and vicinity, *Williams 798*.

Perhaps the outstanding *Carludovica* of Panama with bifid leaves, because of the liana-like stems and lustrous fruiting spadices with unusually large pistillate flowers.

9. CARLUDOVICA KILLIPII Standl. Field Mus. Publ. Bot. 22:65. 1940.

Plants stout. Leaves long-petiolate, coriaceous; blades 60–100 cm. long, bifid for about ⅔ their length, the segments 8.5–12.0 cm. broad, shortly acuminate; petioles stout, 55 cm. long with a bifid vagina 30 cm. long. Peduncles 30 cm. long, 0.5–0.7 cm. thick; spathes 8–10, caducous, borne along about the upper half of the peduncle; fruiting spadix cylindrical, 5–8 cm. long and 1.0–1.5 cm. thick, the flowers small, about 0.35 cm. broad, the stigmas sessile.

Panama and northwestern Colombia, in lowland forests.

DARIÉN: Cerro de Garagará, Sambú basin, *Pittier 5658*.

10. CARLUDOVICA PALMATA R. & P. Syst. 291. 1798.

Carludovica incisa Wendl. Ind. Palm. 67. 1854.
Carludovica gigantea O. Ktze. Rev. Gen. 2:737. 1891.

Fig. 71
Carludovica palmata

Plants stout, acaulescent. Leaves long-petiolate; blade broadly flabellate, divided into 3–5 wedge-shaped segments, each in turn subdivided into numerous acuminate sectors, about 40–80 cm. broad and long; petioles relatively slender, about 1–2 m. long. Peduncles slender, about 20–45 cm. long; spathes usually 4, congested immediately below the spadix, 30–50 cm. long, the outer green, frequently with foliaceous, palmate appendages, the inner creamy white and petalaceous; spadix narrowly cylindrical, 10–12 cm. long, about 1 cm. thick; fruiting perigonial lobes deltoid-trigonal, 1.0–1.5 mm. long, about as long as the pistils.

Southern Mexico to Peru, in lowland forests.

BOCAS DEL TORO: Isla Colón, *von Wedel 1208, 2806;* Río Cricamola, *Woodson, Allen & Seibert 1921*. CANAL ZONE: Matachín, *Kuntze s. n.;* Las Cruces Trail, *Hunter & Allen 454*.

The Panama Hat Palm is one of the abundant plants of the lowland forests of Panama. The young leaves of this species provide the fibre from which the so-called "Panama hats" are made, although the industry actually is restricted to

Ecuador. Popular names in Panama are *Palmilla, Palmita, Jipijapa, Portorrico,* and *Atadero.*

11. CARLUDOVICA DRUDEI Mast. Gard. Chron. 2:714. 1877.

Plants stout, acaulescent. Leaves long-petiolate; blade broadly flabellate, divided into 3 wedge-shaped segments, each in turn subdivided into numerous acuminate sectors, about 1 m. broad and long; petioles rather slender, 1.5–2.0 m. long. Peduncles stout, 40–50 cm. long; spathes 4, congested immediately below the spadix; spadix narrowly cylindrical, 11–12 cm. long, 1.5 cm. thick; fruiting perigonial lobes very narrowly lance-trigonal, acuminate, 7–8 mm. long, somewhat foliaceous, far surpassing the pistil.

Panama and Colombia, in lowland forests.

CHIRIQUÍ: Puerto Armuelles, *Woodson & Schery 910.*

12. CARLUDOVICA ROTUNDIFOLIA Wendl. ex Hook. f. Bot. Mag. *pl. 7083.* 1889.

Plants stout, acaulescent. Leaves long-petiolate; blade broadly flabellate, divided into 3 wedge-shaped segments, each in turn subdivided into numerous acuminate segments, 0.8–1.5 m. broad and long; petioles 1.5–2.0 m. long. Peduncles about 0.5 m. long; spathes 4, congested immediately below the spadix, the outer pair green, tipped with a small digitate blade 15–25 cm. long, the inner pair white, petalaceous; spadix broadly cylindrical, 9–10 cm. long, 3.0–3.5 cm. thick; fruiting perigonial lobes broadly oblong-trigonal, 2.5–3.0 cm. long, much surpassing the pistils, somewhat foliaceous and spreading.

Costa Rica and Panama, in highland forests.

CHIRIQUÍ: Bajo Chorro, *Woodson & Schery 675;* Volcán de Chiriquí, Quebrada Velo, *Woodson & Schery 248.*

2. CYCLANTHUS Poit.

CYCLANTHUS Poit. Mém. Mus. Paris 9:35. 1822.
Cyclosanthes Poeppig, Froriep. Notiz. 31:312. 1831.
Discanthus Spruce, Jour. Linn. Soc. Bot. 3:196. 1859.

Plants acaulescent, terrestrial, lactescent. Leaves spiral, deeply 2-cleft, resembling those of many species of *Carludovica.* Spadix immediately subtended by 5–7 petalaceous or somewhat foliaceous spathes. Staminate and pistillate flowers arranged in separate, alternating cycles, those of each cycle adnate and more or less completely confluent; staminate flowers naked; pistillate flowers enclosed by 2 rims of fleshy tissue representing the concrescent perianths, staminodia numerous, short. Fruit a syncarp consisting of the various fleshy cycles of pistillate flowers, somewhat resembling a large screw.

Two or three species of tropical America.

1. CYCLANTHUS BIPARTITUS Poit. Mém. Mus. Paris 9:35. 1822.
Discanthus odoratus Spruce, Jour. Linn. Soc. Bot. 3:196. 1859.

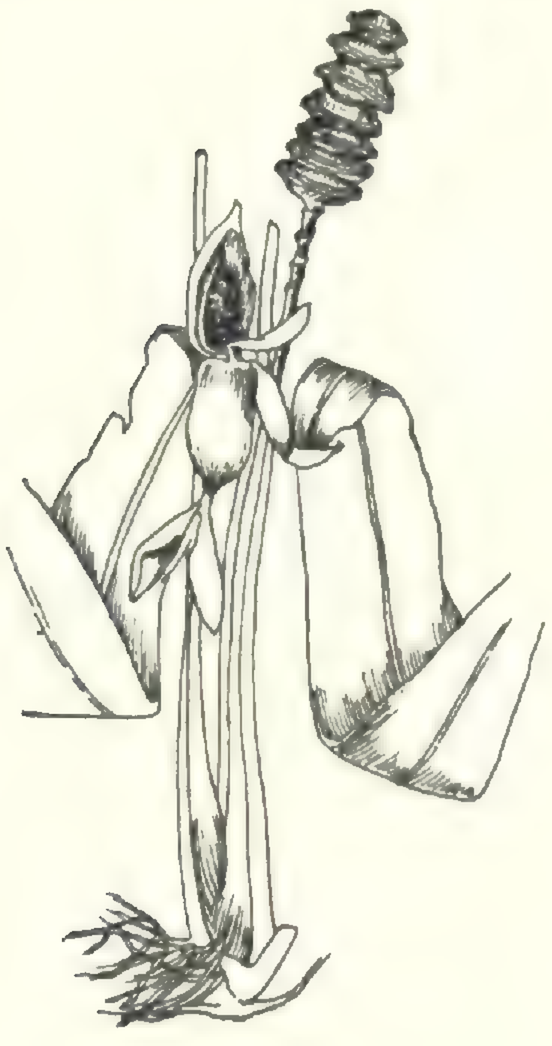

Fig. 72
Cyclanthus bipartitus

Plants fairly stout, acaulescent, frequently forming colonies. Leaves long-petiolate; blade 50–100 cm. long, almost completely bifid, the segments ensiform, narrowly acuminate, 7–15 cm. broad; petioles 35–80 cm. long. Peduncles 40–90 cm. long; spathes broadly ovate, the inner cream-color, the outer somewhat foliaceous; spadix cylindrical, 5–8 cm. long, 1.5–2.5 cm. broad.

Guatemala to Peru, Trinidad, and northeastern Brazil, frequent in lowland forests.

BOCAS DEL TORO: Bocas del Toro, *Carleton 56.* CANAL ZONE: Río Indio, *Maxon 4863;* Las Cascadas, *Standley 25725;* Fort Randolph, *Maxon & Harvey 6511;* Quebrada Bonita, *Steyermark & Allen 17209.* CHIRIQUÍ: San Bartolomé, *Woodson & Schery 895.* COCLÉ: El Valle de Antón, *Allen 1809.* COLÓN: Porto Bello, *Christopherson 402.* DARIÉN: Cana, *Goldman 1895.*

The popular name is reported as *Portorrico.*

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SWEET CORN IN JALISCO

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Any careful inquiry into the origin of a cultivated plant presents a twofold problem: the origin of the plant and the origin of its use. These two lines of inquiry yield two different kinds of evidence whose relative importance may vary greatly from crop to crop. It may even vary for different kinds of the same crop, as for example, dent corn and sweet corn, two characteristic forms of *Zea Mays*.[1] For dent corn the genetical situation is complex; the cultural one is simple.[2] For sweet corn, the opposite is true. Therefore, genetical evidence is more decisive in studying the origin of the former, cultural evidence in studying the latter.

As Erwin ('31, '42) has pointed out, the origin of sweet corn presents no particular problem genetically. Though there is more than one allelomorph of the gene for sweet and though in some stocks of maize a genetically sweet kernel will give little outward indication of that fact, the difference between sweet and non-sweet is a single gene difference. Sweet corn, therefore, can arise spontaneously from any ordinary maize; it is possible and even probable that sweet corns may have originated in various places and at various times.

Culturally, however, the story is more complex. While the change is a simple one genetically, it presents the maize grower with a product quite different from that which he had previously. Unlike the change from flinty to floury or from

[1] The word "corn" is used throughout this paper to refer to maize *(Zea Mays)*. While the latter term customarily is used in scientific papers because of its greater precision, its adoption here would result in the unnatural compound "sweet maize", a term which never is heard in the regions where "sweet corn" is grown.

[2] Dents differ from non-dents by a very large number of genes (Hayes, '12). The genetical story is a complicated one, but once it is understood we shall have critical evidence concerning the origin of dent corns from their presumably undented ancestors. A slightly dented variety will differ but little from flour corn in composition or texture; a strongly dented kernel will be almost like a flint. Among the various varieties of corn grown by the Indians of the American Southwest the undented and "semi-dented" varieties often are used for the same purposes, and many of the varieties show a mixture of undented and slightly dented ears. Accordingly, cultural data will have relatively little bearing on the history of the dent corns.

non-dent to dent, this mutation produces a kernel which for most purposes is decidedly inferior to that of non-sweet maize. At the same time, it produces a kernel which can be used in various new ways when once its capabilities are recognized.

Sweet corn is therefore a peculiar product which usually must be, and frequently is, used in special ways. Although the cultural evidence is somewhat diverse, eventually it should cast light on the early history or histories of sweet corn as a cultivated crop. The present paper does not attempt to discuss this general problem; it merely presents as fully as possible the evidence concerning the morphology, the cytology, the distribution, and the uses of sweet corn in Jalisco, Mexico. When similar information is available from other critical areas, it should then be possible to attack the larger problem.

MORPHOLOGY

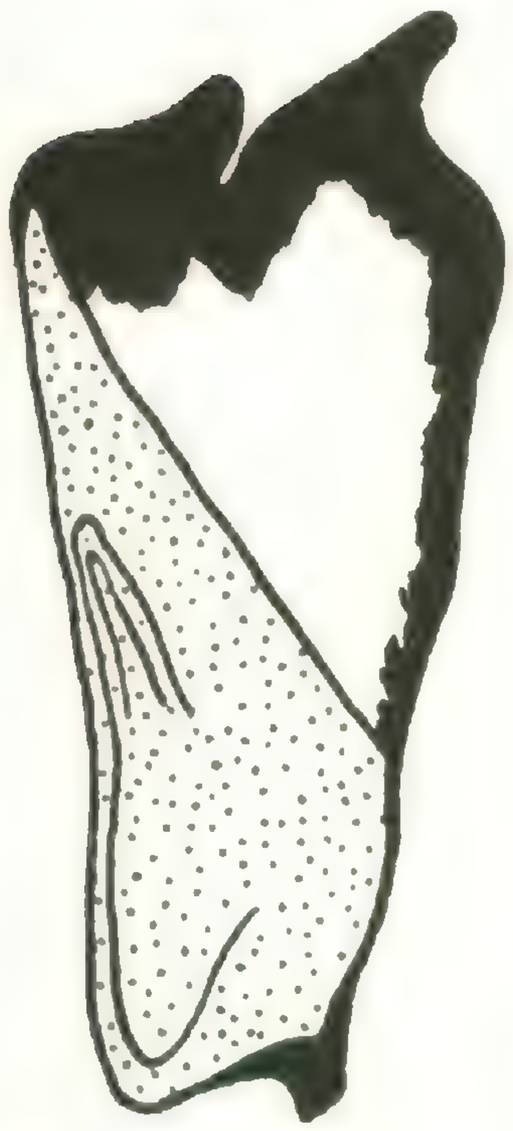

Fig. 1. Longitudinal section of a kernel of Jaliscan sweet corn. Stippled area indicates embryo. In endosperm, black indicates sugary and white indicates starchy.

A detailed summary of ear, cob, and kernel characters in our collections is presented in table 1 (see Anderson and Cutler, '42), and typical ears are illustrated in pl. 4. It will be seen that the grains, while similar in general appearance to commercial varieties of sweet corn, are characteristically not quite so shrunken. This impression is confirmed when the kernels are examined histologically. The endosperm is not completely sugary but has starch stored at the base as shown in fig. 1. It is therefore unlike the sweet corns of the United States, which ordinarily have no such basal starch zone. Mangelsdorf and Reeves have given a preliminary report ('39, p. 257) on these Mexican sweet corns. They are apparently due to another allelomorph of the gene for sweet and are further affected by a modifying gene in the tenth chromosome. The tests necessary to work out the exact genetic constitution of Jaliscan sweet corn would be difficult to make in the United States since these varieties have a very long growing season.

The color of the dried kernels varies from a bright orange-yellow to deep red. The endosperm is yellow, and the various shades of orange and red result from varying amounts of color in the pericarp. We have neither seen nor heard of a white sweet corn in Jalisco although this color is common among flour corns, dent corns, and popcorns in that area. Sweet corn sometimes is said to be "*negro*", but this probably refers to the dark red ears; a dark red flint from Unión de Tula is called "*maiz negro*" merely because it is dark-colored when cooked.

TABLE I

SUMMARY OF EAR, COB, AND KERNEL CHARACTERS IN JALISCAN SWEET CORN

("s" indicates that a character is strongly developed; "w" that it is present but not extreme. All measurements in centimeters.)

Locality	Ear length	Mid-ear width	Shank diameter	Row number	Row width	Kernel thickness	Husk striation	Base compression	Color
Unión de Tula	14	5.2	1.4	20	.9	.4	w	s	Red
Unión de Tula	16	4.6	1.6	16	.9	.4	w	s	Light orange
C. Guzmán	13	5.1	1.9	16	1.0	.5	s	s	Red
C. Guzmán	16	5.7	1.7	20	.9	.4	w	s	Dark orange
Ameca	20	4.9	2.2	16	1.0	.4	w	s	Dark red
Ameca	19	4.7	1.8	20	.8	.5	s	s	Orange
Ameca	18	4.3	1.8	12	1.2	.5	s	s	Yellow

Ten to fifteen plants were grown from each of the three ears collected at Las Canoas, near El Chante, Autlán. They were planted at the Blandy Experimental Farm of the University of Virginia, at Boyce, Virginia, in early May and did not flower until the middle of September. In long season, as well as in other ways, they were very similar to the characteristic small-kernelled flints or popcorns of Jalisco which bear a general resemblance to most of the "hot country" varieties of maize from the Colorado River to the deserts of Chile. Detailed measurements are presented in table II. In general, the plants were tall, slender, and tough. The internode diagram of a typical plant is illustrated in fig. 2. Tillers were frequent and often numerous (see table II), and the tillers were morphologically so like the main stalk that by the time the plants had begun to tassel it was often difficult to tell which was the primary shoot and which were secondaries.[3] The leaves were slender and tough and were undamaged in windstorms which played havoc with collections from Guatemala and from Michoacán.

TABLE II

SUMMARY OF PLANT AND TASSEL CHARACTERS FOR 3 EAR-TO-ROW TESTS OF JALISCAN SWEET CORN

Plant No.	Tiller Number			Number of tassel branches	Glume length in cm.	% condensed internodes	% sub-sessile spikelets
	Min.	Ave.	Max.				
24a	1	4	5	27	1.2	10	0
24b	0	2	3	31	1.1	0	0
24c	0	2	3	21	1.1	30	0

[3] It must be noted that several traits exhibited in the experimental plantings are not characteristic of sweet corn when it is grown locally in Jalisco. In the first place, the remarkable tillering qualities above described are abnormal. In Jalisco, sweet corn, and other maize varieties as well, ordinarily produces a single stalk; for this reason several kernels are planted together. In the second place, the rare secondary stalks which appear are easily distinguishable from the primary shoot since they remain somewhat stunted. In the third place, in Jalisco, sweet corn does not require an excessively long season but ripens coincidentally with most other types of maize; green ears are available approximately three months after planting. However, dent corn from Michoacán did not tiller when grown in Virginia, nor did it require such a long growing season.

The ears characteristically were shorter, thicker, and more rounded than those of other Jaliscan maize. They bulged in the middle rather than tapering sharply and evenly like most Mexican maize. Since cob shape depends upon a very large number of genes, it is one of the best criteria of relationship. It is therefore significant that Jaliscan sweet corns tend very strongly to have a cob shape which is different not only from other Jaliscan maize but also from most other Mexican

Fig. 2. Internode diagram of a typical plant of Jaliscan sweet corn as grown at Blandy Farm. Circle represents the tassel.

maize. It is, however, a shape which is common in parts of South America and which also occurs in Guatemala. In this connection it is interesting that when the kernel color pattern is revealed by contamination with starchy corn (pericarp colors are difficult to distinguish on a background of sweet endosperm) it is one which is common in Guatemala but very rare in most of Mexico, being deep red at the base and fading towards the top so that the yellow endosperm shows through.

The leaves were practically glabrous, with only a few long scattered hairs at the top of the sheath, and both leaves and stems were a bright, shiny green, with only a trace of anthocyanin pigment. By the time the plants were well developed they were so slender, green, and tough, and there were so many tillers, that they

resembled a bamboo thicket rather than a field of North American sweet corn. The tassels developed so late in the season that their development was probably somewhat abnormal. However, they seemed to be similar to most other Jaliscan maize in having large open tassels with many widely separated branches and large coarse glumes. Anthers and silks were uniformly green.

Conclusions from morphological data.—In general, Jaliscan sweet corn is similar to the other maize of that region and is particularly close to the slender, small-grained popcorns which apparently have been there for a very long time. Its most important differences are the larger, broader, more rounded ear and the peculiar red and yellow color. The cob size and shape are comparatively uniform from collection to collection, and there is less color variation than among other kinds of Jaliscan maize. Its uniformity and its slight but constant cob differences suggested that Jaliscan sweet corn may have originated elsewhere. In any case, it appears either to have been extensively mixed with Jaliscan maize or to have originated from a closely related stock.

CYTOLOGY

Pachytene acetocarmine smears were made from one plant at the Blandy Experimental Farm. The data are summarized in table III. While they will be much more significant when our knowledge of knob number and distribution in various races of corn is more complete, they already confirm the above conclusions derived from pure morphology. In general, the distribution of the knobs and their number and size are like those of other Jaliscan maize, the two small sub-median knobs on the sixth chromosome and the very large terminal knob on the ninth being particularly characteristic.

TABLE III

KNOB NUMBER AND DISTRIBUTION IN JALISCAN SWEET CORN

("s" indicates a small knob, "T" a terminal knob.)

Chromosome Number	1	2	3	4	5	6	7	8	9	10
Average for Jalisco (non-sweet)	0	1	1	1	1	3 (2s)	1	0	T	0
No. 25	0	1	1s	1s	1	3 (2s)	1	0	T	0

DISTRIBUTION AND USES

Sweet corn, or *maiz dulce*, as it is known in Mexico, is general throughout the state of Jalisco, although it is not grown on a large scale. It has a wide altitudinal zonation, from La Huerta, in the Purificación, to El Jazmín, and throughout the Los Altos zone.[4] No information is available from the Pacific seaboard (Puerto

[4] Actual elevations are not readily ascertainable. The 1926 Scanlon map, published by the Secretaría de Agricultura y Fomento, indicates that La Huerta has an approximate elevation of 500 m., whereas the Los Altos district ranges from 1500 to 2000 m.

Vallarta, Tomatlán, Sihuatlán, etc.), but it may be predicted confidently that sweet corn will be found in this coastal stretch. In fact, of the areas of Jalisco which we know, only the upland, almost sub-alpine, district of Tapalpa is said definitely to lack *maiz dulce*. The latter evidently has a considerable tolerance to cold since it is grown in the more sheltered spots about El Jazmín, on the north flank of the Volcán de Colima, where maize and beans alike require six months to mature.

Collections have been made in the following areas: Ameca; Las Canoas, El Chante, Autlán; Tuxcacuesco; Telcampana, near San Gabriel; Sayula; Ciudad Guzmán (Zapotlán); Tuxpan; Tenamaxtlán; Mascota; Talpa; Ayutla; and Teocaltiche. In addition, although we have no samples, informants definitely report sweet corn from: La Huerta, Purificación; Zapotitlán; El Jazmín; San Pedro Tlaquepaque; Jalostotitlán; San Juan de los Lagos; Lagos de Moreno; and Encarnación.

In Jalisco sweet corn is not a commercial crop and is grown chiefly for home consumption. It is offered for sale only in small quantities and, as far as we know, invariably in the form of confections (see below). It is essentially a product of the *ranchos* and small *pueblos;* if not actually scorned by city people, it is regarded by them as a somewhat rustic food. Ordinarily sweet corn is planted in the *milpas* as a summer *(temporal)* crop, although there is no physical reason why it should not be grown in irrigated plots or in gardens. The feeling seems to be that it is not of sufficient importance to warrant the bother of irrigating.

The cultural data presented below apply primarily to western Jalisco, specifically to the Ameca-Autlán-Tuxcacuesco districts. A few supplementary data suggest that as regards maize utilization western Jalisco may differ somewhat from the Los Altos zone, the great expanse of high-steppe country which extends from Lake Chapala northeastward. From personal observation and from the interrogation of a limited number of informants from diverse parts of the state, the general *maiz dulce* picture appears to be as presented below.

The potential uses of sweet corn are restricted and overlap relatively little with those of the less specialized forms of maize. First and foremost, it must be made clear that *maiz dulce* is not considered satisfactory for *nixtamal* (the dried, mature maize kernel, which is steeped with lime in hot water and when softened is ground on the *metate* to produce the *masa* for making *tortillas*). However, in certain areas (Sayula, Tuxpan, and apparently through much of the Los Altos zone), sweet corn is used for *atole*, a sort of maize gruel.[5] This is not a general practice in western Jalisco.

---

[5] Several types of *atole* are known in Jalisco, and our data do not specify which of these may be made from sweet corn. Probably it is not the *atole* which has a *nixtamal* base, since it is said specifically that sweet corn is not suitable for the preparation of this near-hominy. Presumably the *atole* in question is made of maize which is boiled (without lime), ground, strained, and served without further ado in a semi-liquid state.

Occasionally, green ears of sweet corn are boiled or roasted, but these are not considered particularly tasty since the maize is gummy and sticks between the teeth. However, in certain areas of Los Altos (Encarnación and Jalostotitlán; *not* in Lagos de Moreno or in San Juan de los Lagos), sweet corn is served as *esquite;*[6] in western Jalisco the latter usually is made with white corn.

Aside from the above-noted uses, which are not general, the culinary functions of *maiz dulce* are pretty effectively confined to two special confections: *pinole* and *ponteduro.*

Pinole[7] is by no means a standard item of diet but is prepared "*por gusto*", when one has a desire for it. Its function is essentially that of a confection. Although of no dietary significance, *pinole* evidently is well established in the local culture, as witnessed by two common proverbs: "No se puede chiflar y comer pinole" (one can't whistle and eat *pinole*) and "El que tiene más saliva come más pinole" (he who has the most saliva eats the most *pinole*). Throughout western Jalisco *pinole* is probably the most common dish made of *maiz dulce.* In the Los Altos zone, specifically in Encarnación and Jalostotitlán, *maiz dulce* similarly is made into *pinole.* However, in two other pueblos of Los Altos (Lagos de Moreno and San Juan de los Lagos), it is said that *pinole* is made exclusively of *maiz negro.* The same is true of the Jalisco-Zacatecas border country (Teocaltiche, Nochistlán), where it is said that sweet corn is too oily for successful *pinole.*

Ponteduro[8] is the second major dish prepared with maiz dulce; it is made throughout Jalisco, wherever sweet corn occurs. A variant of *ponteduro* is known as *pipitoria;* the ingredients are the same but the sweet is shaped into thin, flat cakes instead of balls or separate coated elements.

It should be clear from the foregoing that *maiz dulce* does not play a major role in Jaliscan diet. It is essentially a basic ingredient of several confections which are prepared only occasionally, much as we roast peanuts, pop corn, or make taffy. In afternoon and evening, vendors may appear on the streets or in the plazas of the small pueblos, offering homemade *pinole, ponteduro,* or *pipitoria,* in company with roasted peanuts, toasted *garbanzos, habas,* squash seeds, and similar local delicacies. As far as we know, the commercial aspects of sweet corn are

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[6] *Esquite* is prepared from roasting ears which are somewhat old and past their prime. The kernels are cut from the cob and toasted in a clay plate or tray *(comal).* They are then removed to another vessel, sprinkled with salt water, and returned to the hot tray until the moisture has evaporated. They are eaten as a confection.

[7] *Pinole* is prepared from dried, shelled, mature *maiz dulce.* The kernels are toasted in an earthen tray and then ground on the *metate* with *panocha* (known also as *piloncillo,* a coarse brown sugar sold in the form of hard cakes or cones) and *canela* (cinnamon bark or a local substitute therefor). The resulting powder is eaten dry or accompanied by a glass of milk; it does not appeal to an untrained palate, being somewhat reminiscent of licorice powder.

[8] *Ponteduro* is the local equivalent of sugared peanuts or peanut brittle. A syrup of *panocha* and water (sometimes milk) is boiled until it thickens. To it are added the dry, toasted kernels of *maiz dulce,* together with toasted squash *(calabacita)* seeds and roasted peanuts. The mixture is removed from the fire and stirred until it hardens. The *panocha* coats the various elements or, if desired, binds them into a ball. The resultant confection is extremely sweet and because of its hardness is something of a test of dental prowess.

confined to this type of informal vending. In fact, the occurrence of sweet corn in Jalisco is a relatively inconspicuous affair and might well escape the notice of a casual traveler.

SUMMARY

The relative importance of cultural and genetic data in determining the origins of crop plants is discussed briefly. Their comparative significance is very different for sweet corns and dent corns. The various morphological and cytological features of Jaliscan sweet corns are described and summarized. While generally similar to other Jaliscan maize, they are more uniform as a group and have larger, broader ears. They are widely, although not commonly, grown in Jalisco by country people, chiefly for home use in the form of two special confections, *pinole* and *ponteduro*.

The data suggest that sweet corn is not a recent introduction in Jalisco. When similar studies are available for other areas, it should be possible to discuss authoritatively the origins of North American sweet corns.

For assistance of various kinds, the authors are indebted to several members of the staff of the University of California, particularly to Professor Carl Sauer, of the Department of Geography.

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Explanation of Plate

PLATE 4

Two ears of sweet corn from Unión de Tula, Jalisco; x about 9/10.

KELLY & ANDERSON—JALISCAN SWEET CORN

THE MAIZE TRIBUTE OF MOCTEZUMA'S EMPIRE[1]

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The original tribute list of Moctezuma's empire is still in existence[2] and can be consulted in the Salon de Codices of the Museo Nacional de Arqueologia at Mexico City. It is made up of thick pages of so-called maguey paper, bound along one edge into a book, instead of being folded back and forth screen-wise like most native codices. It was primarily a very practical, book-keeping document, and the glyphs were not fantastically elaborated as in more ceremonial codices; they are strong and effective cartoons of the kinds of tribute. Four hundred years have not completely obliterated the simple colors of the original, and the glyphs of the maize plant still show green leaves, yellow tassels, and ears with green or dark red silks. The tribute list is arranged by provinces, a province to a page (see plate 5). The glyphs for the towns are arranged around the lower and outer edges of the page. The tribute due from the province fills up the interior of the page, the various articles being arranged in a more or less standardized fashion, so that maize and beans are in the upper left-hand corner on fifteen of the sixteen pages where they occur. The glyphs, while crudely drawn, are nearly always effective representations of the tribute: jars of honey, mantles of cotton cloth, live eagles, etc., from the top of which protrude the glyphs for number (digits, banners, purses, as the case may be).

The original list has undergone several changes, some of which enhance its value to us. It was annotated in Náhuatl ("Aztec") in early post-conquest times and even more briefly in Spanish at a later date. Unfortunately, these annotations have never been adequately reproduced in any of the "editions" which the manuscript has suffered. About eight pages are now missing, some of them having disappeared since a copy was prepared for the 'Codex Mendocino'.[3] This latter well-known 'Codex' was made up for the Emperor Charles V by an Indian copyist who worked in such haste that he inserted a statement to that effect as an apology to future scholars.[4] The document was designed to tell the emperor something about his new possessions and, along with copies of several pre-conquest documents,

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[1] The form Moctezuma will be noted. Though Montezuma (with an 'n') is deeply rooted in English, it is a barbarism.

[2] Matrícula de Tributos, No. 52, Salon de Codices, M. N. de Arque.

[3] In the 18th century Archbishop Lorenzana reproduced the 'Matrícula' (the tribute list) in his edition of Cortes' letters. It was then more complete than to-day. A century ago the United States Ambassador Poinsett (from whom the Poinsettia gets its name) carried off a fragment to Philadelphia, and this has only recently been recovered.

[4] See in this connection an interesting paper by Gómez de Orozco, Rev. Mex. de Etudios Antrop. 5:43-52.

it incorporated some new material. The copy of the tribute list is extensively annotated in Spanish and forms the second part of the 'Codex Mendocino'. That document never reached the Emperor Charles but fell into the hands of French pirates. After a long and adventurous career it came to rest in the Bodleian library at Oxford. It has been published and cited so often as to obscure the importance of the originals on which it is based.

The age of the original tribute list can be approximately set within the last decade of Moctezuma's rule since it includes Tlaxiaco, a town not conquered until 1511[5], among the towns which paid tribute. It therefore gives us an unusually

[5] The widespread belief that Tlaxiaco was conquered in 11. Acatl (1503) rests on the mistaken annotation of a picture in the 'Codex Telleriano Remensis'. Actually it was conquered in 1511 or 1512, as will be shown below. It may be argued that Tlaxiaco was subjugated long before, in the middle of the 15th century, and lost, and that it was kept in the tribute list just as the English kept up their claim to Calais. This is more than doubtful. While it is true that the Texcocans made important conquests in the Mixteca in the late 1450's these did not include Tlaxiaco. And, in any case, the presence of the Pacific province of Cihuatlan, conquered by Moctezuma's predecessor, is evidence that the 'Matricula de Tributos' was compiled no earlier than the previous reign, which ended in 1502. Evidence for 1511 or 1512 as the date of Tlaxiaco's conquest is as follows: The year 6. Acatl (1511) is given in Lehmann's edition of the Anales de Quauhtitlan (Mexiko und Colhuacan, verse 1277) and in Chimalpahin, septieme relation. Ixtlilxochitl, I, 258, says the same, the name here being corrupted into Alasquiyauh. In the 'Codex Aubin' and the unpublished 'Codex Mexicanus' (Cf. Boban, pl. 23-24) of Paris 7. Tecpatl (1512) is given. The same time is implied in Torquedmada's story of the event (I, 215), which he places in the 10th or 11th year of Moctezuma II. Moctezuma acceded in 1502, according to the 'Telleriano'. The Mexicans "went against those of Tlachquiauhco" at that time "and destroyed them, leaving nothing in the town, and brought back Malinal, the lord of that province, as prisoner. And all those who were captured in this war were killed" in the dedication of new temples. Altogether, "12,210 persons were sacrificed." This included Malinal, according to Ixtlilxochitl (I,258).

Fig. 1. The Tlapalizquixochitl Tree

The cause of this campaign was the refusal of Malinal to sell or give Moctezuma a famous flowering tree called *Tlapalizquixochitl*, says Torquemada (I, 196). Of this Sahagun, in his chapter on flowering trees (Lib. XI, Cap. VII, Sect. 10), says: "There are other flowers which are called *Tlapalizquixochitl*, and they are so called not because they are red all over, but because they are spotted and striped with red." Nicholas Leon has identified this plant as no. 685 A of the Paso y Troncoso edition of 'Codex Florentino' plates to Sahagun (see fig. 1).

The question of the date of Tlaxiaco's conquest is resolved, indeed, by the very 'Codex Telleriano', if we disregard the European-added text, and look at the original native picture for the year 6. Acatl (1511). A warrior, dressed for his death in the gladiatorial sacrifice, is shown with the glyph of a ball-court *(tlachtli)* and falling rain *(quiauitl)* which make up the word Tlachquiauhco (Tlaxiaco). There is no reference to this in the Spanish commentray. If Tlaxiaco fell in 6. Acatl (1511)—which all the evidence indicates—what is the meaning of the ball-court-and-rain glyph given under 11. Acatl (1503) in the 'Telleriano'? It is certainly to be read Tlachquiyaucho. The commentator, at a loss, interprets the rain symbol twice and speaks of rain *(quiauitl)* in *Tlachquiauhco* (more exactly, he calls it snow). Now weather was not a favorite topic in these laconic Indian records, where many a monarch got in only by being born and dying. The explanation of the Tlachquiauco glyph in the 'Telleriano' in the year 11. Acatl (1503) may be sought in the 'Historia Tolteca-Chichimeca': "In the year 11. Acatl (1503) Tlachquiauitl, lord of Tepexic, was conquered. He was conquered by the Mexicans". This was because Tlachquiauitl had attacked the chief of Quauhtlatlauhcan. Both of these towns lay within the Mexican province of Tepeacac, and the overlords didn't want their tributaries burning each other's corn-fields. Hence the redundant glyph, so long misread as "Tlachquiauhco" in the 'Telleriano Codex.'

accurate and detailed picture of Moctezuma's empire at the height of its expansion. Barlow's recent[6] identification of the provinces and towns of the tribute list with present and prehistoric Mexican sites makes it possible to plot the distribution of the maize tribute in detail, province by province. In the following list the provinces are given in the order in which they appear in the 'Codex Mendocino' copy, and each province is identified by the town whose glyph initiates the series of towns of the province. Modern names are given in parentheses when they are unlike the ancient names. In a few cases where the page has been divided into sub-provinces the same rule has been followed in selecting the leading towns. A hyphen has been used below in listing these "sub-provinces."

TRIBUTE BY PROVINCES

Tlatelolco	no maize
Petlacalcatl	one crib
Acolhuacan	one crib
Quauhnahuac (Cuernavaca)	one crib
Huaxtepec	one crib
Quauhtitlan	one crib
Axocopan (Ajucuba)	one crib
Atotonilco	one crib
Hueypuchtla	one crib
Atotonilco (el grande)	one crib
Xilotepec	one crib
Quahuacan	one crib
Toluca	two cribs
Ocuilan	one crib
Mallinalco-Xocotitlan	two cribs
Tlachco (Taxco)	one crib
Tepequacuilco	one crib
Cihuatlan	no maize
Tlapan	no maize
Tlalcoçauhtitlan-Quiauhteopan-Yoaltepec	no maize
Chalco	six cribs
Tepeacac (Segura de la frontera)	two cribs
Coayxtlahuacan (Coixtlahuaca)	no maize
Coyolapan (region of Oaxaca City)	two cribs
Tlachquiauco (Tlaxiaco)	no maize
Tochtepec	no maize
Xoconochco (Soconusco)	no maize
Quauhtochco (Huatusco)	no maize
Cuetlaxtlan (Cotastla)	no maize
Tlapacoyan	no maize
Tlatlauhquitepec	no maize
Tuchpan (Tuxpan)	no maize
Atlan	no maize
Ctzicoac	no maize
Oxitipan (Ciudad Valles region)	no maize

The above list raises three special problems: the size of the tribute; the interval of payment; the area of the maize tribute. They will be discussed in that order.

[6] Barlow, R. H. Ibero-Americana. (In press).

1. *The size of the tribute.*—Throughout the tribute list the maize is shown in big square wooden corn cribs or granaries (see pl. 5). The annotator of the 'Codex Mendocino' refers to them in Spanish as "troxes" and says that one troxe holds 4 to 5,000 hanegas[7]. For the next province he says[8] it takes 5,000 hanegas to fill a troxe. Thereafter the size is given by the annotator as being the same as those already described. An hanega (or "fanega" as it is written in modern Spanish) is a notoriously loose term of dry measure. The modern Spanish fanega has been equated to 1.6 English bushels, which would be slightly over 2 American bushels. For Mexico 2.5 American bushels is a conservative equivalent. This would mean that the tribute was paid in units of around 10,000 bushels.[9] This tribute was apparently of shelled corn rather than corn on the cob. The glyph is always a representation of a corn grain rather than an ear of corn and in the original tribute list, corn, beans, *chia (Salvia hispanica)* and *huautli* (Amaranth seed) are usually summarized and represented in the same troxe. Moreover, shelled corn ("en grano") is mentioned in other tribute reckonings (see note 9).

The cribs were apparently large wooden affairs set up off the ground on rocks or posts. The glyph always shows them with a top and a bottom and with a varying number (usually seven) of straight horizontal boards in between. The glyphs are always colored a light red-brown, as if they were wooden. In all but one instance the crib is represented with a door or ventilating hole slightly above the middle. On the original manuscript this door (if such it be) is left uncolored or colored the same as the rest of the crib, or in one instance is painted light gray. There is nothing in the glyph to suggest that it was a crude open crib. It must rather have been some kind of carefully fashioned imperial granary. There is no indication of cracks between the logs or boards and the ends are finished off square. Furthermore, exactly the same kind of glyph is used for the storage cribs for beans and for chia seed which would certainly have required a tight, carefully built structure. From other sources[10] we have a written description of the imperial storehouses at Texcoco. Speaking of the court buildings there, the account goes on to say:

> "To the north of the above mentioned houses and near the kitchens were several granaries (graneros) and bins (troxes) of astonishing magnitude in which the king had a great quantity of maize and other seeds which were kept for the lean years and each of them contained four or five thousand hanegas and they were kept in such order that the air entered on all sides so that the seeds lasted many years".

The usual tribute for a province was one crib of corn, but in several instances two or more were exacted. The total number on the list is 28, which would make the total tribute 28 times 10,000 or in round numbers 300,000 bushels of maize. This number is of course only an approximation, but it does give at least a notion

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[7] "en cada un troxe cabyan quatro y cinco myll hanegas lo qual tributauan una vez en al año." [Cod. Mendocino. *f. 21 R*].

[8] Cod. Mendocino. *f. 22 V.*

[9] In native units the tribute represented 4,000 tlacopintlis. See Anderson & Barlow: Tlalocan 1^2:. 1943.

[10] Ixtlilxochitl **2**:266.

of the general order of magnitude of the maize tribute. It was certainly in the tens of thousands of bushels, and it might have been in the neighboorhood of a million bushels.

2. *Interval of payment.*—Without exception, the maize tribute is indicated as being paid once a year. Other tribute might be paid at various intervals; twice a year, four times a year, six times a year (as, for instance, the *chian pinole* tribute from Tlatelolco), but the maize in every instance was to come in once a year. This fact may be of some significance in determining the chief maize-growing methods of the empire. In modern Mexico the maize harvest may come at different times of year depending, among other things, upon whether or not it is grown on irrigated land or depends upon the natural rainfall. However, maize of the empire (or at least the kind or kinds used as tribute) was apparently an annual crop.

3. *The area from which the tribute was collected.*—The distribution of the tribute by provinces is shown in fig. 2. It should be remembered that the provin-

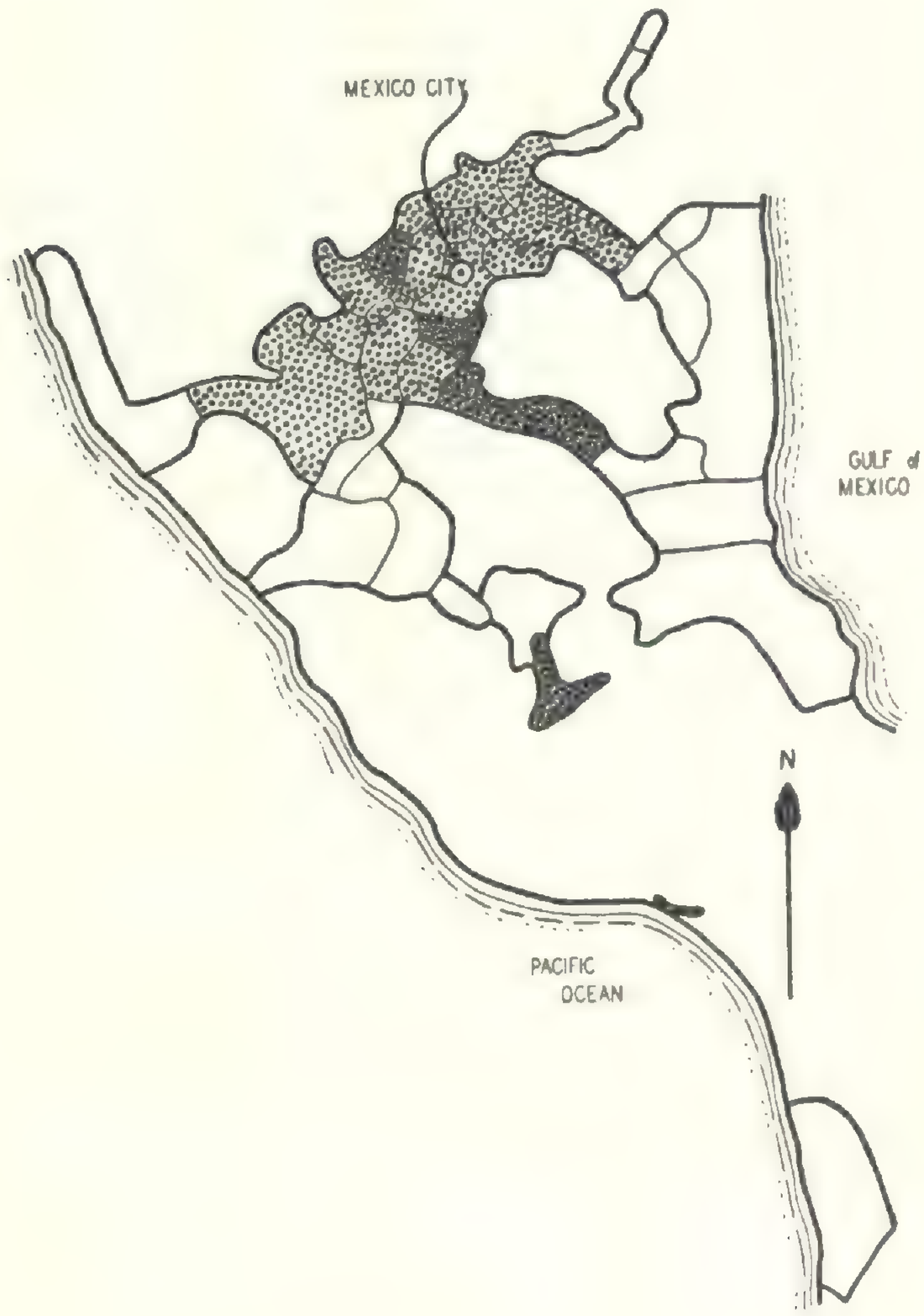

Fig. 2. Map showing the approximate distribution of Moctezuma's empire at the time of the conquest. The heavy line shows the boundary of the empire; the narrow lines are provincial boundaries. Those provinces paying tribute in maize are stippled; heavy stippling represents tribute of more than one crib per province. The authors are indebted to Professor A. L. Kroeber of the University of California for permission to use the original map upon which the figure is based.

cial boundaries as shown in this map are tentative and that a good many details may have to be changed as critical information accumulates. For the purpose at hand, however, it is quite adequate. It will be seen that the maize tribute was very logically distributed. It was levied upon all provinces near the Valley of Mexico and with one exception was not brought from a great distance. For most provinces the tribute was one crib (troxe) of maize, the chief exceptions being the southern end of the Valley of Mexico where the province of Chalco was responsible for five cribs and the Valley of Toluca which contributed two.

The only distant province to pay tribute in maize was that of Coyolapan, which included the region near the present city of Oaxaca. Why it should have been levied upon this province and not from the fertile regions closer to the Valley of Mexico is a puzzle. It is possible that the maize sent from Oaxaca was of a special sort which could not be raised in the cooler climate of the capitol cities. It is also possible that the maize tribute gathered at Oaxaca was not forwarded to the Valley of Mexico though such information as we have been able to find does not bear out this assumption. It is clear from various early Spanish documents that the tribute of this list was independent of, and in addition to, supplies which supported the local garrisons. We know, for instance, that in Totoltepec "they did not give tribute because they formed the frontier with Michoacan and supported the soldiers which they had there, Mexicans, and those of the fortress of Oztoma."[11]

Other documents show that at least a portion of the imperial maize tribute was raised in special fields. "They made a large planting (sementera) all the town together, and what they gathered from this was brought together by these governors and they gave it every year to Moctezuma."[12] The aborigines (Matlatzinca) who remained in one of the border towns after the flight of most of the village when this province was conquered by the Mexicans in the 1470's "made a planting for the lord of Mexico which was 800 brazas long and 400 brazas wide."[13]

Summary.—The tribute list of Moctezuma is described and the tribute in maize is summarized by provinces. The maize tribute was paid once a year and is believed to have been roughly 300,000 bushels. A provisional map of the empire is given showing the distribution of the maize tribute, which for the most part was limited to the provinces closest to the capitol cities in the Valley of Mexico.

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[11] Papeles de Nueva España 6:149.

[12] Epistolario de Nueva España. 6:276.

[13] Zurita. Relación de Texcoco. p. 221.

Explanation of Plate

PLATE 5

Negative photostat copy of the page of the 'Matrícula' devoted to the province of Atotonilco el Grande. The glyphs for the six towns of the province are along the bottom of the page. They are, from left to right, Atotonilco, Acaxochitla, Quachqueçaloyan, Hueyapan, Itzihuiquilocan, and Tulançinco. These place glyphs are like rebuses. The last one, for instance, is made up of the glyph for reeds *(tulan)* and the glyph for little (*çintli*, represented by the nether half of the human body). In the upper left hand corner of the page are the glyphs for cribs *(troxes)*. On top of each crib is the glyph for corn (right) and beans (left). The rest of the tribute of this province consisted of four ceremonial costumes (complete with head-dresses, nose plugs, and shields) and mantles (1600 plain and 800 fancy). The glyph resembling a fern frond which rises from the top of each mantle glyph is the glyph for 400 *(centzontli)*. Immediately below the "troxes" an early scribe has made two brief lines of annotation in Náhuatl. Below this a still later annotator has written six further lines of Spanish.

ANDERSON & BARLOW—MAIZE TRIBUTE

ON THE VASCULAR ANATOMY OF THE CYCADEOID CONE AXIS[1]

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The great fossil cycad beds of the Black Hills in South Dakota and the Freezeout Hills of Wyoming have yielded a tremendously valuable store of knowledge concerning the internal structure of this early and highly specialized group of plants. Nevertheless, a considerable number of questions remain unanswered concerning the Cycadeoids themselves as well as their affinities with other groups. Some of this information will be obtained from further study of the specimens that have long reposed in American museums, and it is hoped that discoveries of new localities will play a still more important part.

It is the purpose of the present contribution to record a fossil cycad locality in the Ferris Mountains of south-central Wyoming and to describe certain imperfectly known features of the vascular anatomy of the *Cycadeoidea* cone axis.

In 1941, when I was collecting fossils in Wyoming, the Ferris Mountain locality was brought to my attention by Mr. W. A. Brox, a geologist and mineral dealer of Rawlins. He showed me a number of silicified cycad fragments in his collection which had been found in those mountains by Mr. Charles Johnson, of Bairoil. Through the generous aid of these two gentlemen a visit to the site was made possible. Only a few supplementary fragments were obtained at that time but these were sufficient to indicate the origin of the specimens. The locality, which was discovered by Mr. Johnson, lies near the west end of the Ferris Mountain range, approximately 10 miles northeast of Bairoil, Wyoming. The fossils had apparently weathered out of the upper Jurassic Morrison formation, in all probability occupying the same or nearly the same horizon as the fossil cycads from the Freezeout Hills, some 50 miles to the east.

Of the specimens obtained from Mr. Brox and from Mr. Johnson, one consists of the apical portion of a columnar trunk. Prior to sectioning for study it was 12.5 cm. long and nearly 15 cm. in diameter. That it is the tip of a trunk or branch is clearly indicated by the rapidly tapering form of the xylary "cylinder" and the dense aggregation of the leaf bases composing the upper surface. The trunk fragment was cut transversely into four sections, and while a study of the exposed surfaces revealed no exceptional features not already known in Cycadeoidean anatomy a number of cone axes was noted. In view of the excellent preservation and the highly gratifying quality of the peels obtained it seemed probable that serial preparations would reveal significant information pertaining to the stem-peduncle xylem transition.

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[1] Issued November 20, 1943.

General Anatomy.—

As is usual in the genus *Cycadeoidea*, the pith is large, measuring 4 cm. in diameter, and it is liberally supplied with irregular, and probably secretory, sacs. These are found both in the cortex and leaf bases and are also filled with a dense brown substance throughout.

The stele consists of a cylinder 6–8 mm. thick (radially) which is frequently segmented by the departure of leaf and cone traces. Xylem and phloem are present in approximately equal quantities and are readily distinguished in transverse and radial sections. The tracheids are predominantly scalariform (fig. 9), and there is no evidence of distinct annular growth in transverse section, the wood presenting the aspect of a single uniform ring.

Where the xylem is undisturbed by departing appendage traces the wood rays are generally uniseriate and of considerable height. A few have been observed only 3–4 cells high but the majority are 15 or more cells high. Not infrequently they tend to be biseriate in the central portion. The ray cell size is very variable, ranging from 105 μ high by 48 μ broad (tangential) to 24 μ x 12 μ.

The Stem-Peduncle Stele Transition.—

In Wieland's monumental treatment[2] of the American petrified cycadean trunks he gives an account of the anatomy of the lower portion of the peduncle stele of *Cycadeoidea Wielandi* Ward. The equipment available at the time rendered impossible the preparation of serial sections, and it is to Wieland's credit that he was able to shed as much light on the stem-peduncle stele transition as he did. However, as he indicates in his summary (p. 73), the description that he was able to present is incomplete and difficult to follow. In view of the seemingly significant and distinctive nature of the peduncle anatomy it seems appropriate to quote his summary:

> The general conclusion is that the peduncular bundle is formed from the union of several different bundle strands in the lower part of its course through the cortex, and that these strands consist primarily of a main branch arising directly from the woody cylinder, which may, however, be connected with either lateral or subtending leaf traces. The leaf traces appear in general to arise from the woody cylinder as horseshoe bundles, with the phloem outside, these bundles soon assuming a more or less brokenly-circular form in the most of their course through the cortex before dividing up in the leaf base.

As a generality, this summary is quite correct although there are many gaps in the description which render it, according to Wieland himself, "unexpected . . . . difficult to explain." In the following paragraphs I shall present a detailed account of the stelar anatomy of the peduncle from its origin in the stem stele to its departure from the trunk as a free appendage.

In following the transition from below upwards the first indication of the departure of a peduncle stelar system presents itself in the form of three arcs of xylem about 4 mm. apart (fig. 1). Of these, the two laterals (*a*, *b*), which are markedly more elongate radially than ordinary leaf traces, depart rather abruptly from the stele while the central trace (*c*), as may be noted in the succeeding photographs, passes out into the cortex much more slowly.

[2] Wieland, G. R. American fossil cycads. Carnegie Inst. Washington Publ. 34[1]. 1906.

Soon after their departure from the stem stele each of the two lateral traces closes to form a radially elongate stele. Almost immediately these become centrally constricted, foreshadowing their rapid division into two more or less equal parts. In fig. 2 it is clear that the two pairs of arcs, a_1, a_2 and b_1, b_2, have resulted from the respective divisions of *a* and *b* in fig. 1. The preservation in the region of the *b* lateral is rather faulty, which accounts for the light streak through the photograph. Aside, however, from some slight size differences, the system is bilaterally symmetrical and consequently we may center the discussion around the more perfectly preserved *a* lateral.

Next the a_2 and b_2 segments of the two laterals pass directly out, each into a petiole base. The further division of these traces in the petioles involves no features that are not already known in Cycadean anatomy and need not be considered further. Now the inner segments of the laterals (a_1, b_1) close in, resulting in two nearly cylindrical steles. These pass to a position closely flanking the now radially extended central trace (fig. 3), open directly toward it, and the three fuse, resulting in a short cross-shaped figure (fig. 4)[3]. This appendage system, which is still connected with the stem stele, is then pinched off (fig. 5) from the latter and tends to take the shape of an ellipse. One more departure is, however, in the order of things. The outer portion (c_1) of the original central trace *c* passes out (fig. 6) into a petiole which directly subtends the peduncle. The stele of the latter then departs from the cortex without further additions or losses. The entire transition from fig. 1 to fig. 6 extends through a vertical distance of 12 mm.

A number of other peduncle steles have been followed through parts of their lower course, sufficient to establish the above description as typical. It seems very likely, moreover, from a comparison with Wieland's figures[4] that essentially the same structural relationships prevail in *Cycadeoidea Wielandi* Ward. Beyond this, a generalization is speculative but in view of the rather close comparison in other anatomical details between *C. Wielandi* and my own specimen with numerous other species of *Cycadeoidea* it seems safe to predict that the transition described here will be found to be typical for most of the closely related species.

Taxonomy.—

If one looks at all carefully into the literature relating to petrified cycadean stems it soon becomes clear that a majority of the specific names are quite meaningless as biologic entities. It seems to have become standard practice to assign a new specific name to each newly discovered specimen. However, it is not as difficult as might be expected to condone this custom despite the abundance of names that results. The fact remains that one rarely encounters paleobotanical specimens that present greater difficulty in their preparation of study material.

[3] One of the initial saw cuts was made near that portion of the block shown in fig. 4. Thus in order to survey the course of the peduncle stele it was necessary to prepare peels from both of the adjoining surfaces. Consequently figs. 4, 5, and 6 are reversed, lateral *b* appearing at the left instead of the right as in the preceding fig. 3. It seemed best to illustrate the series this way since somewhat inferior prints were obtained when the negatives of either half of the series were reversed.

[4] Wieland, op. cit. pp. 69-71.

This, coupled with the hesitancy on the part of many investigators to dissect specimens of museum-display quality, has resulted in the description of a great many specimens concerning which little or nothing of importance is known. Ward's descriptions, based almost exclusively on external characters, are very nearly worthless. Until the internal structure of those species is investigated the names remain only as catalogue numbers. Even in Wieland's informative and beautifully executed volumes I personally find it difficult to single out distinctive characters for very many of the numerous species that are recorded.

This is perhaps a weak excuse to carry on a weak and incomplete system. Nevertheless, the Cycadeoid described here might be "tentatively assigned" to a number of recorded species, one, all or none of which choices might be correct. In view of this uncertainty it seems that less ultimate confusion will arise if it is recorded, for the present, as a distinct taxonomic entity.

Cycadeoidea Broxiana Andrews, n. sp.

Species based on the apical portion of a columnar type trunk; pith 4 cm. in diameter, containing abundant secretory sacs, the latter also found in cortex and petioles; stele a single cylinder 6–8 mm. thick, xylem and phloem quantitatively equal, tracheids scalariform, rays uniseriate, occasionally biseriate, cells very variable in size; ramentum abundant about bases of petioles and peduncles; leaf trace branches about 20, ventral ones turned strongly inward; periderm well developed in cortex of peduncle and peduncular bracts. Type specimen *(#1463)* deposited in the collections of the Henry Shaw School of Botany, Washington University, St. Louis.

Acknowledgment.—

I wish to express my sincere appreciation to Mr. W. A. Brox, of Rawlins, Wyoming, for valuable aid in the field and his unselfish gift of botanical specimens of scientific value.

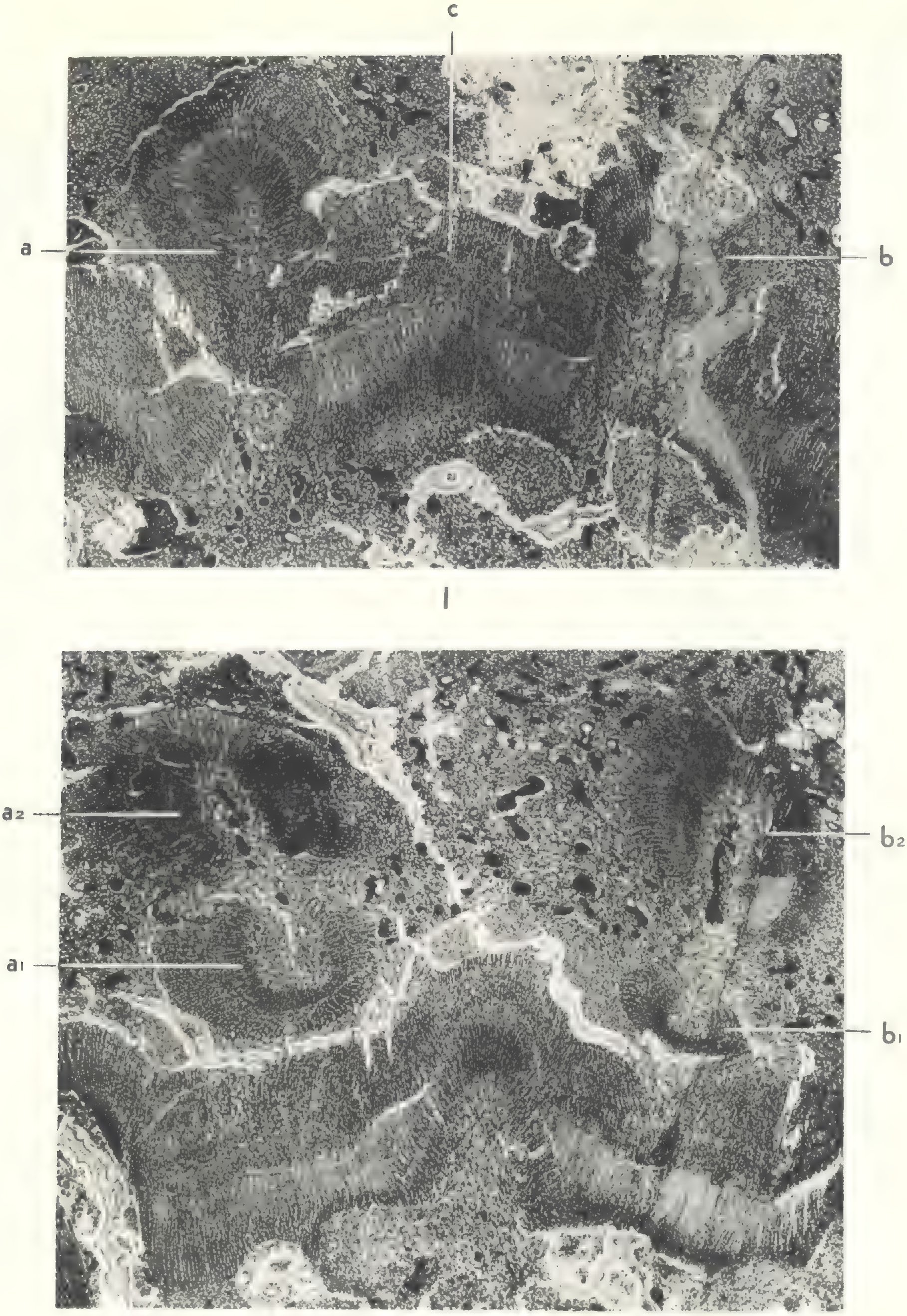
Explanation of Plate

PLATE 6

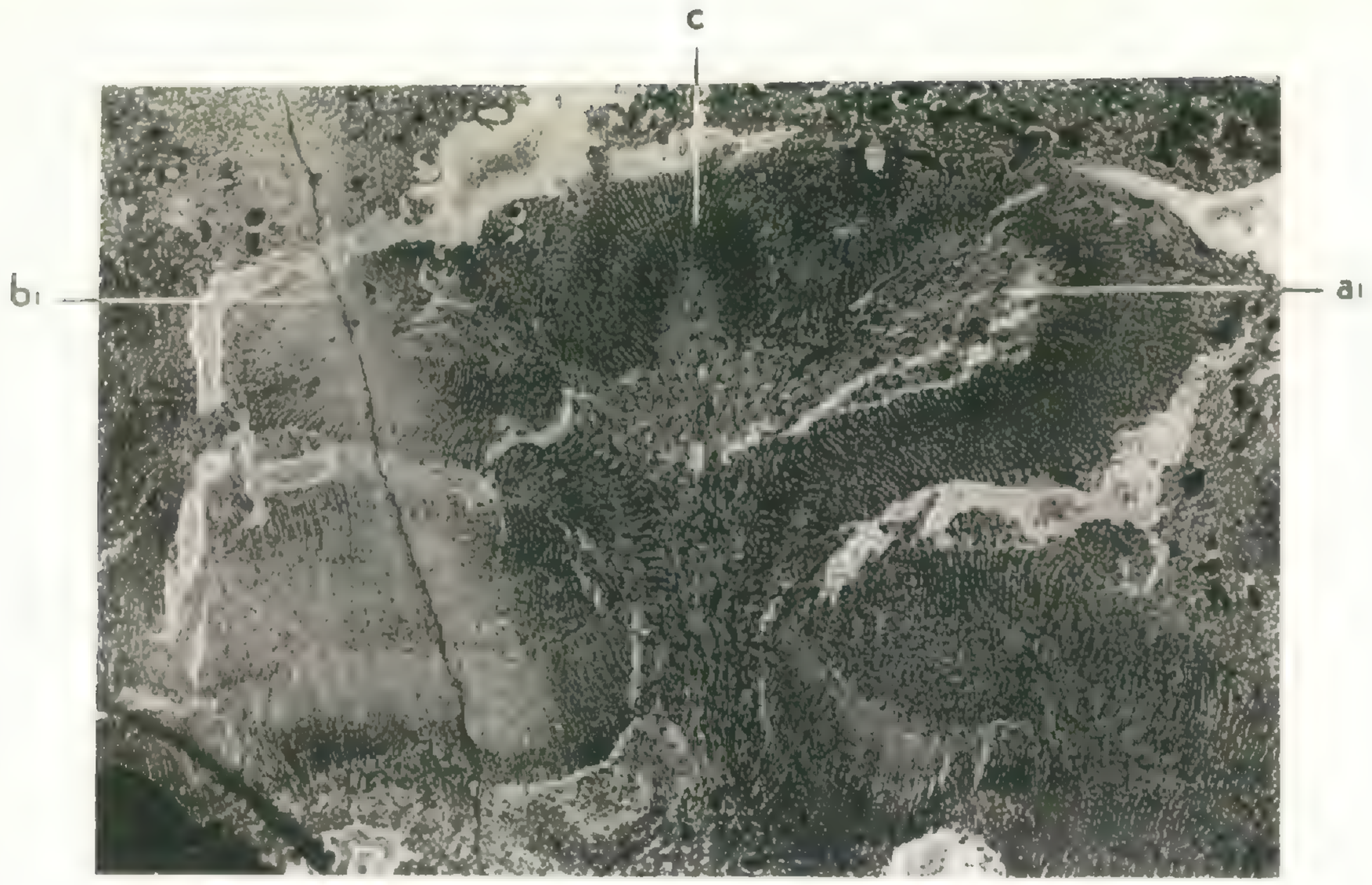
Cycadeoidea Broxiana

Fig. 1. Transverse section through stem stele showing origin of peduncular traces; *a*, *b*, lateral traces, and *c* central trace. 1463C-a, t27; x 5.

Fig. 2. Same at a higher level showing division of the lateral traces. The traces, a_1, a_2 and b_1, b_2 have resulted from the tangential divisions of *a* and *b* (fig. 1) respectively. 1463C-a, t17; x 5.



ANDREWS—THE CYCADEOID CONE AXIS



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3

ANDREWS—THE CYCADEOID CONE AXIS

Explanation of Plate

PLATE 7

Cycadeoidea Broxiana

Fig. 3. The laterals a_1 and b_2 have closed and are about to fuse with the now elongated central trace. 1463C-a, t8; x 5.

Fig. 4. Showing fused lateral and central traces. 1463B-B1; x 5.

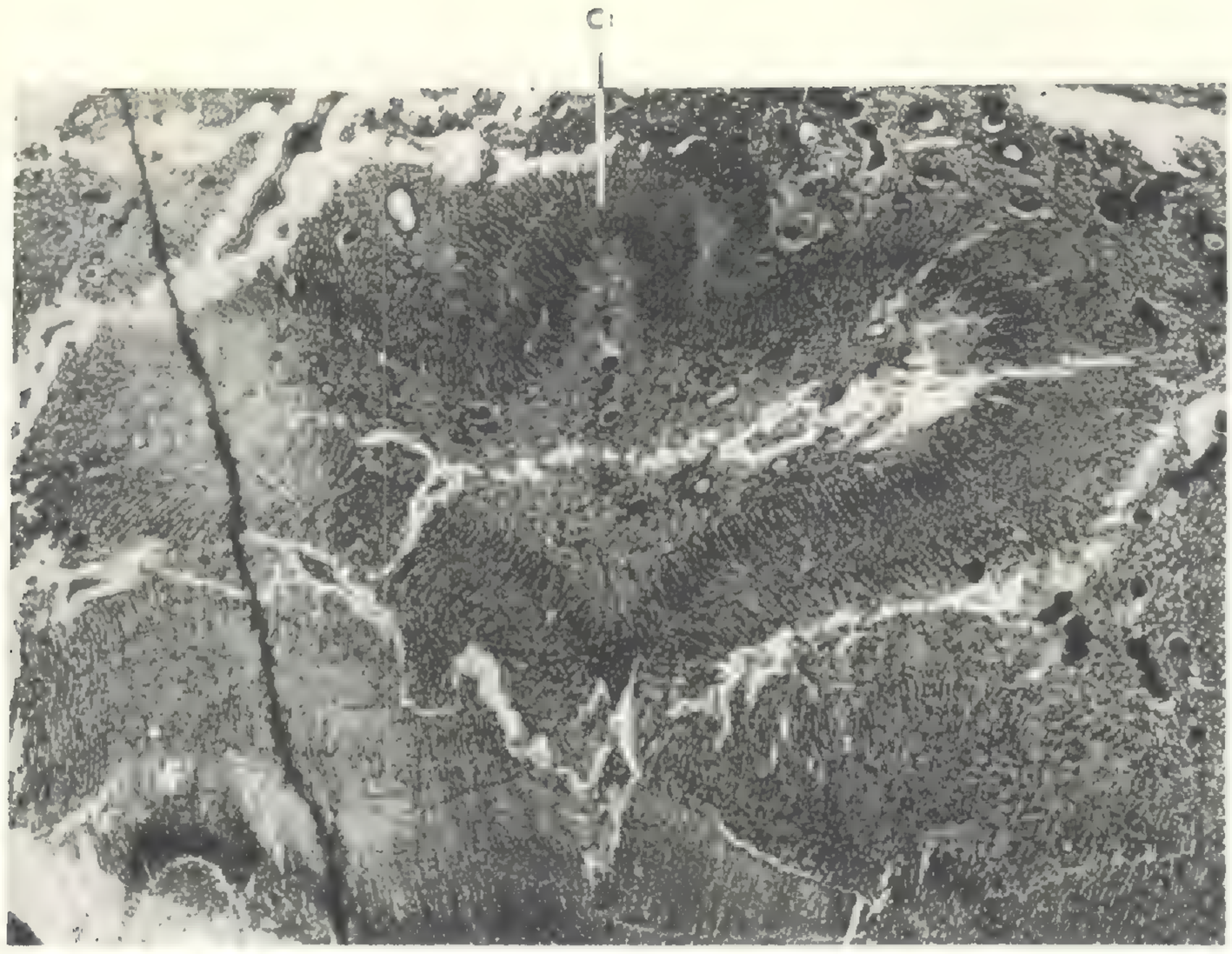
Explanation of Plate

PLATE 8

Cycadeoidea Broxiana

Fig. 5. Showing departure of peduncular stele from stem stele. 1463B-a, b12; x 5.

Fig. 6. Showing departure of trace from peduncle stele into subtending petiole. 1463B-a, b27; x 5.



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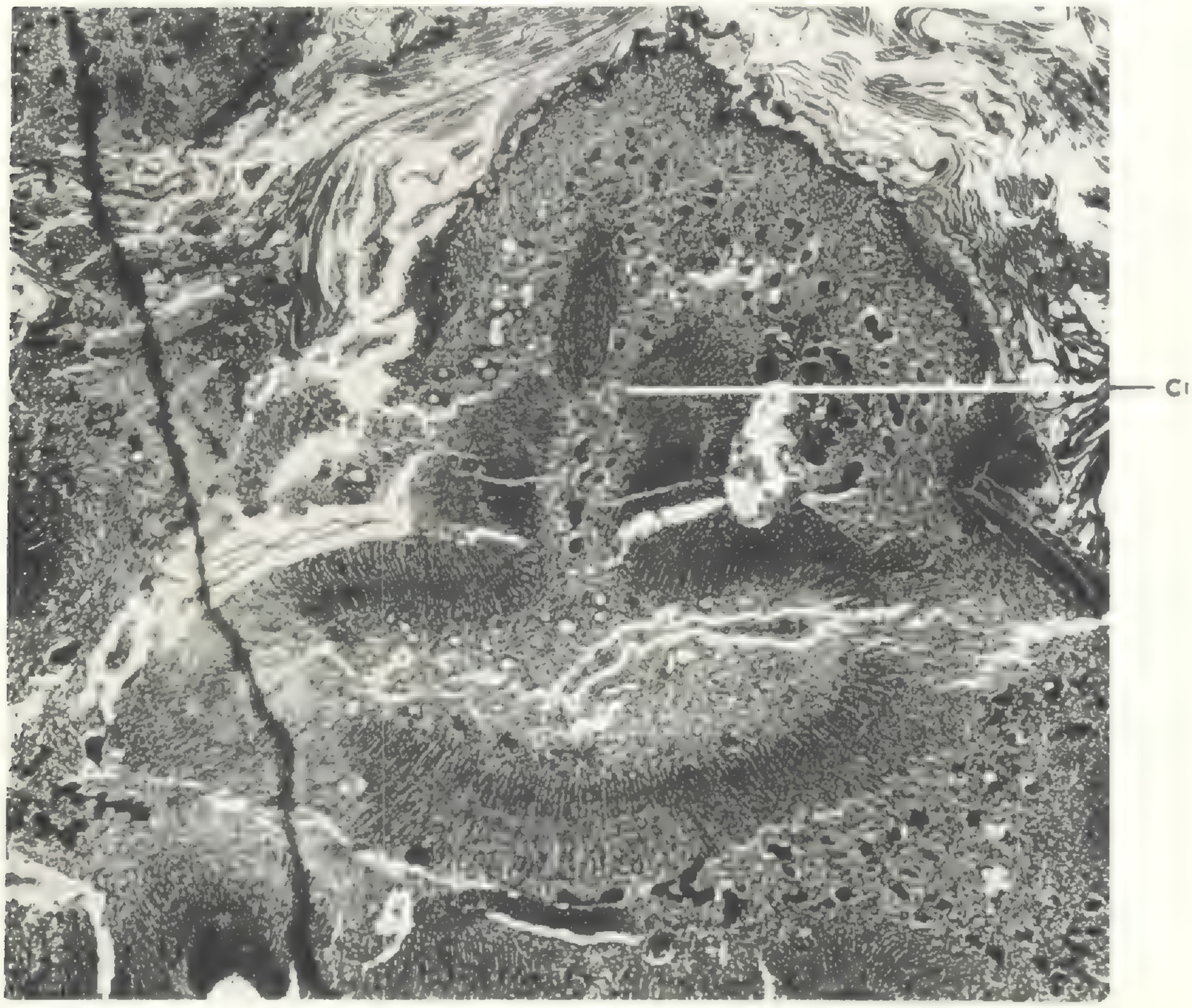

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ANDREWS—THE CYCADEOID CONE AXIS

8

9

7

ANDREWS—THE CYCADEOID CONE AXIS

Explanation of Plate

PLATE 9

Cycadeoidea Broxiana

Fig. 7. Cross section through base of peduncle. 1463A-A, b15; x 5.

Fig. 8. Cross section through ramental scales. 1463A-A, b2; x 80.

Fig. 9. Radial longitudinal section through stem wood showing scalariform pitting of tracheids. 1463D-b, s1; x 380.

CONTRIBUTIONS TO OUR KNOWLEDGE OF AMERICAN CARBONIFEROUS FLORAS[1]

VI. Certain Filicinean Fructifications

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Carboniferous plants collected from the roof shales of American coal mines received comprehensive treatment at the hands of paleobotanists of a half century ago, the better known and basic contributions being those of Lesquereux ('80-'84) and White ('99). However, in view of our increased knowledge of the floras that these men dealt with, as well as the recent innovations in the technique of handling compression fossils, extensive revisions in the literature are necessary. Furthermore, modern methods now render very valuable the comparatively small, scattered, and fragmentary specimens of fertile fronds that apparently had been discarded in favor of the larger and more attractive museum-type of specimen. In most cases these were sterile and in themselves of little biological value.

During the past year I have obtained, largely through the kind offices of Mr. John Jones, Safety Superintendent of the Old Ben Mines, in Franklin County, Illinois, a number of interesting specimens bearing filicinean fructifications. The specimens are not numerous, and generally only small portions of the entire frond are present. They do, however, display characters pertaining to the morphology of spores and sporangia, characters that are considered to be of prime importance in the diagnosis of living forms. Although our investigations thus far must be considered as only an introduction to more extensive and critical studies, it seems advisable to present the results to date in view of current war-time regulations which prevent further collecting in the shaft mines.

All of the specimens described in the following pages were obtained from the roof shales of the Old Ben Mine No. 11. These shales overlie coal No. 6 and constitute the basal member of the McLeansboro formation (upper Allegheny), being of upper-middle Pennsylvanian age.

SCHIZAEACEAE

Senftenbergia Corda. 1867.

This genus has come into prominence recently by Radforth's ('38-'39) demonstrations that *Dactylotheca* Zeiller is founded on a misconception and that forms previously assigned to it must be referred to *Senftenbergia* or *Asterotheca* (Radforth, '42). Furthermore, it has been shown that *Senftenbergia*, so far as its critical characters are concerned, belongs emphatically in the Schizaeaceae. Specimens of the type that Kidston believed referable to *Dactylotheca* have long been

[1] Issued November 20, 1943.

known in America, but modern technique has now confirmed Radforth's conclusions from American material in striking fashion. The material studied was obtained in association with fronds of *Pecopteris plumosa* var. *dentata,* discussed below, and strongly suggests that the characters exemplified by the *Senftenbergia* pinnae are correlative with these sterile fronds.

Technique.—

The technique employed was essentially the same as that described by Radforth in the above-cited papers, and by Andrews and Pearsall ('41) for carbonaceous compressions of a Cretaceous *Anemia.* Only one well-preserved specimen was available, and, in order to obtain sufficient sporangia without affecting the specimen, small portions, about 1 cm. square, were removed with needles, the fossil side coated with a nitrocellulose solution and immersed in dilute hydrofluoric acid overnight (very small fragments were placed in the acid directly). When the shale-free sporangia were then placed in the oxidizing fluid (nitric acid and potassium chlorate), followed by washing in dilute ammonia water, their walls gradually cleared, revealing the contained spores. Three to four hours were sufficient, in most cases, to bring about the almost complete disintegration of the sporangium wall, isolating the spores as a unit mass (figs. 7, 8). The material thus prepared was mounted in "crystal white" Karo.

Senftenbergia plumosa (Artis) Radforth var. **Jonesi** Andrews, n. var.

Judging from the two pinnae composing the specimen (fig. 1) they are parts of a comparatively large frond, and the size attained by the supposed sterile frond (or portion thereof) supports this assumption. Almost the entire under-surface of the secondary pinnae appears densely clothed with sporangia (figs. 2, 3) which are attached by a short stalk (figs. 4, 5). The mature ones that have shed their spores exhibit but little variation in size, averaging .52 x .26 mm. The annulus is distinctly Schizaeaceous, consisting of a nearly apical ring of two rows of longitudinally elongate and irregularly interlocking cells (figs. 5, 17). It is difficult to locate specimens which display the apical plate in end view, since the great majority of the sporangia have been laterally compressed in fossilization. Figure 16 shows the distal end of a sporangium, from which it seems clear that the apical plate consists of a number of cells, comparing closely with the apical plate of living *Anemia* species.

Many of the sporangia still retain their spores. The less mature spores are smooth-walled and adhere together tenaciously in a more or less ovoid mass, although tapering somewhat toward the proximal end (fig. 8). The mature spores (fig. 9) are approximately 50 μ in diameter and are characterized by irregular ridges and stout spines which may be forked at their tips.

During the course of treatment in the oxidizing fluid one sporangium was observed in which the spores were almost mature judging from their sculpturing,

yet still retained together in a unit mass after dissolving the sporangium wall. Most of the spores were readily separated with a needle, and the number determined was approximately 118. That the spore mass represents the entire contents of a sporangium was evinced by its uniform shape conforming to that of the sporangium as a whole prior to treatment.

It is not possible to discern distinctly a lamina in the fertile pinnae but that such was present seems evident from the abundance of epidermal hairs that clothe not only the pinna rachis (fig. 15) but the secondary pinnae as well. The hairs and sporangia cover a sufficiently wide area as to leave no reasonable doubt that a lamina was present although it may have been somewhat narrower than the sterile foliage.

The hairs vary somewhat in size, are branched (figs. 6, 17), and display irregularly thickened cross-walls. The technique involved in handling such delicate structures was necessarily specialized and is perhaps worth a separate notation. A portion of the specimen was dipped in 20 per cent hydrofluoric acid for about one minute. This cleared the dark gray shale to a much lighter shade and tended not only to partially liberate the sporangia and hairs from the matrix but, due to the increased color contrast, greatly enhanced study and photography. Hairs were then carefully removed with needles and placed in the oxidizing fluid for about three minutes. After washing and treatment with ammonia water the larger branched ones appear as shown in fig. 17. If the oxidation time is prolonged the hairs become nearly colorless and so fragile as to be exceedingly difficult to manipulate.

Discussion.—

Of the European species of *Senftenbergia* described by Radforth our specimen agrees very closely with *S. plumosa*. The general appearance of the sporangia and their contents is almost identical in the two and they compare very closely in size as shown in table 1.

TABLE I

A DIMENSIONAL COMPARISON OF THE SPORANGIA AND SPORES OF *S. PLUMOSA* AND *S. PLUMOSA* VAR. *JONESI*

	Sporangium length (mm.)	Sporangium width (mm.)	Spores per sporangium	Spore diameter (μ)
Senftenbergia plumosa (Artis) Radforth	.54	.27	200	50
S. plumosa (Artis) Rad. var. *Jonesi*	.52	.26	118	50

It may be seen that there is no appreciable difference in sporangium or spore size although a discrepancy appears in the reported number of spores per sporangium. I am inclined to believe that Radforth's number, which is based on calculation, is high in view of the fact that the one given here is based on an actual count and the spores and sporangia of both agree very closely in size. The structure of the annulus and spore exine sculpturing also compare very closely

(cf. Radforth, '38, pl. II, fig. 6). Radforth's figures do, however, seem to display a more prominent lamina than the Illinois specimen, although this may be due simply to poorer preservation in the latter. Because of that difference, as well as the variation in reported spore output and certain variable characters relating to the supposed sterile foliage, it seems advisable to designate the specimen described here as a distinct taxonomic entity.

STERILE MATERIAL

Pecopteris plumosa var. **dentata** (Bgt.) White.

We have found associated with the above-described fertile material numerous specimens of a Pecopterid-type frond. In view of our knowledge of the foliage of other species of *Senftenbergia,* as well as certain characters exemplified by S. *plumosa* var. *Jonesi* which are correlative with this particular *Pecopteris,* this will be considered in some detail.

This plant and its close relatives have been described many times and there is little occasion to repeat the descriptions. Although the outline of the large fronds may have been lance-shaped, it nevertheless seems inappropriate to describe a highly pinnatifid leaf of this sort as "lanceolate." Part of Kidston's ('24, p. 385) description of fronds which he referred to *Dactylotheca plumosa* applies very well to our specimens. "The pinnules on the middle ultimate pinnae are oval-triangular or broadly lanceolate (in general outline) with rounded apices, and united by the whole width of their base to the rachis. The basal inferior pinnule is deltoid-rounded, generally smaller than the others, and occupies the angle formed by the insertion of the pinna on its parent rachis, and frequently has a distinct lobe; the superior basal pinnule is oval or oval-oblong, obtuse, and is almost invariably the largest pinnule on the pinna. The uppermost pinnules become gradually more united to each other and form a more or less lobed, and finally an entire blunt apex to the pinna." Bell ('38, p. 76) also mentions "the punctate rachides of primary pinnae," . . . "the contiguous, smooth-surfaced pinnules which have convex, upper surfaces and a tongue-shaped or subtriangular form. The apparently pointed apices of the pinnules in some specimens have resulted from inrolling of the margins, . . ." This last feature is particularly noted in transfer preparations of the Old Ben material; the infolding may ostensibly shorten the distal inferior pinnule margins in unprepared material by more than half a millimeter and serve to give them a notably triangular aspect so that some of the pinnae appear rather sharply serrate as shown in fig. 13. The venation and form of the basal pinnules are shown in text-fig. 1.

The specimens at hand are notably larger than those described from the Barnsley horizon. The one illustrated in fig. 14, at reduced size, is the most delicate yet seen in the Old Ben material, and it appears significantly more robust than Kidston's Yorkian forms. In a recent collection we obtained a particularly fine and large frond fragment. Judging from the size of the primary pinnae, the

Text-fig. 1. Venation and shape of superior and inferior basal pinnules of *Pecopteris plumosa* var. *dentata*. x 5.

longest of which measures 37 cm., it is safe to say that the frond attained a length of between 1 and 2 meters.

Nearly all of our material is well preserved as coalified compressions. All the veins are sunken on the upper surface which is almost invariably exposed. When portions of the upper side of the lamina do remain attached to the rock the counterpart is apt to still carry a skeleton of the veins distinctly impressed. Thus the veins of pinnules are shallow grooves in the upper surface and prominences of the lower surface. The primary and secondary rachides show a number of irregularly spaced papillose protuberances which no doubt represent enlarged and sclerified hair bases. These are on both upper and lower surfaces of the primary rachis but seem more limited to the lower surface of the secondary branches; the tertiary rachides do not show them clearly, partly because the basal pinnules overlap the rachis (cf. text-fig. 1) and probably also because the emergences on this part of the frond are more delicate. On the secondary rachides the hairs are by no means as numerous as shown by Radforth ('38, p. 1, fig. 1) on a Barnsley specimen.

Cuticular preparations have been made from median pinnae similar to those shown in fig. 13, and from this same specimen. The structure varies dorsally and ventrally and in relation to the veins. Over the veins on the upper surface the cuticle is thin and in maceration frequently splits apart along them. The fragment shown in fig. 11 represents the upper cuticle between the bifurcate tips of one of the lateral veins. Although the central cells tend to be isodiametric, pentagonal or hexagonal, many are elongated. The largest are about 40 x 70 μ in diameter; more isodiametric cells measure about 35 μ. The central elongate cells show no special orientation but toward the veins their long axes parallel the nervation and over the veinlets the cells are still narrower. Due to the delicacy of the cuticle these cell markings are shown indistinctly. Other cuticular fragments show that the veins extend to the margin of the lamina which may be very slightly indented. The cuticle is thicker at the margin, tending to show very elongate rugose markings as may be seen in fig. 10, which represents the ventral and dorsal cuticles connected at the leaf margin and spread out in a single plane. The lower cuticle is much thinner than that covering the upper surface. The cells are elongate, roughly rectangular, and tend obliquely from the margin as shown in figs. 10 and 12. The largest cells are about 30 x 80 μ, the smallest ones 20 x 40 μ. Triangular cells are seen where the oblique lower pattern merges with that of the margin. Neither stomates nor hairs have been observed on these cuticles. Presumably the stomatal areas are on the lower surface where the cuticle is thinnest and least readily obtained by maceration procedure.

It is difficult to compare these data with those given by Radforth for the sterile fronds he has identified with *Senftenbergia plumosa*. The small cuticular fragment he has figured (pl. 1, fig. 3) shows elongate, truncate-lenticular cells averaging about 45 x 15 μ, and what appears to be a hair base. It seems clear that his specimens are easily distinguishable from those described here. This lends further support for the taxonomic distinction of our material, at least in so far as the sterile specimens are concerned, from the older more delicate Yorkian forms.

The differences between our material, identified as variety *dentata* (Bgt.) White, and that which Kidston and Radforth have shown for the Yorkian *Pecopteris plumosa* may be summarized as follows: in var. *dentata:*

1. Fronds more robust.
2. Rachides more sparsely hirsute.
3. Lower cuticles show a somewhat different type of cell pattern.

MARATTIACEAE

Scolecopteris Zenker. 1837.

This genus is based on elongate, stalked synangia composed of 3–5 exannulate sporangia. Certain workers have expressed the opinion that *Scolecopteris*, *Asterotheca* and associated genera may be Pteridosperm micro-sporangiate fructifications. I am inclined, however, to accept the more universally prevalent view that

they are of Marattiaceous affinities. A more detailed consideration of the taxonomy of the group follows on a later page.

Scolecopteris Radforthii Andrews, n. sp.

Pinnules 1½ times as long as broad; pinnule vein branches once dichotomous; synangia of 3–4 sporangia, in two rows, on vein terminations, near margin of pinnule; spore masses 550 μ long, 165 μ broad; spores 32 μ in diameter, calculated number 900 per sporangium. The species is named for Dr. N. W. Radforth in recognition of his contributions to our knowledge of Carboniferous ferns.

Although this species is based on a small fragment of a frond bearing parts of ten ultimate pinnae the spore-bearing organs are well preserved, and there is no reason to doubt that it is a representative portion of a fertile frond. The sterile foliage is not known. The pinnules are about 1½ times as long as broad and ascending (fig. 20). The vein which passes out from the pinna rachis gives off side branches of which the proximal ones dichotomize once while those near the tip of the pinnule may remain unbranched (fig. 18).

The spore-bearing organs consist of synangia borne in two rows near the margin of the pinnules, each synangium being at the terminus of a vein.

Following oxidation treatment the cleared sporangial walls reveal the spore masses within (figs. 21, 22). Each synangium is composed of 3–4 partially united sporangia. The spore masses themselves are distinct in most cases and average 550 μ long by 165 μ broad. There is some variation, however, in the degree of the union of the sporangia into a synangium. One of the synangia was isolated in which the spore masses were united through the greater part of their length and others have been observed in which the basal part of the spore masses seems to have been fused. These instances are exceptional and perhaps due in part to maceration of the sporangium wall, for in most cases the sporangia tend to become isolated as distinct unit masses of spores.

Dehiscence is by means of a longitudinal slit extending the length of the inner side of the sporangium. The sporangia composing a synangium are apparently rather loosely held together and in most cases split apart at maturity.

The spores, such as those shown in figs. 21, 22 and apparently immature, measure 32 μ in diameter, are smooth-walled, spherical, and display a tri-radiate commissure. A few have been observed bearing slender unbranched spines, but completely mature ones have not been found. According to the method given by Radforth ('39, p. 746), the spore output of each sporangium would be calculated as 1090. The sporangia vary in length from 500 to 700 μ but most are approximately 550 μ. Since these measurements pertain to the isolated spore masses which filled a sporangium and do not include the wall, the size of the whole sporangia would have been appreciably greater. The specimen illustrated in fig. 22 may be taken as a typical example. The fact that the sporangia taper at their distal end would make their total volume somewhat less than that of an ellipsoid (the geometric figure assumed in the above-noted calculation) of the same minor and major

axes. Taking this into account an estimate of 900 spores per sporangium may be considered as reasonably accurate. Thus, each synangium produced some 2700 to 3600 spores depending on whether it consisted of three or four sporangia.

The rather crowded nature of the sporangia and the compression that they have undergone make it difficult to portray their organization clearly in a photograph. Consequently, the restorations shown in figs. 23 and 24 have been prepared to present their probable appearance before and after dehiscence in life.

Discussion.—

It becomes increasingly evident that the Marattiaceae, or at least plants bearing Marattiaceous fructifications, were abundant in species as well as numbers of plants in the Carboniferous forests. Of the spore-bearing organs that have been referred to this family the two genera *Scolecopteris* and *Asterotheca* are among the better known, and considerable controversy has arisen as to whether *Scolecopteris* deserves generic rank or whether the species assigned to it should be included within *Asterotheca.*

In his "Handbuch" Hirmer ('27, p. 576) considers *Scolecopteris* as synonymous with *Asterotheca,* and Radforth ('42), in his discussion of *A. parallela,* proffers the same opinion. The present writer feels that this course places entirely too wide a range of spore-bearing structures within a single genus. If one compares typical *Asterotheca* fructifications such as those illustrated by Hirmer (p. 582) for *A. truncata* with species such as Radforth's *A. parallela* ('42, pl. 1, fig. 3), it will be noted that the synangia of the latter appear more or less cylindrical and elongate as compared with the usually flattened disc-like shape of *Asterotheca.*

The macerated synangia of *Scolecopteris Radforthii* (figs. 21, 22) are rather closely comparable with Radforth's figure ('42, pl. 1, fig. 5) of the corresponding structures of *A. parallela;* so similar in fact as to leave little doubt that the two are congeneric. The gross organization of the synangia (figs. 19, 20) is, however, certainly not correlative with *Asterotheca.* The synangia of *A. parallela* and S. *Radforthii* are elongate and stalked, which accounts for their less orderly arrangement in the compressions, especially of the latter. The objection may be raised that the appearance of "typical" *Asterotheca* fructifications is due to compression. It is extremely improbable, however, unless they were naturally short and disc-shaped, that such regularity would result in the fossil state. The restoration of S. *Radforthii* shows the probable appearance of the fertile pinnules in life. Synangia such as these, upon compression, lie more or less flat (longitudinally) against the lamina and so lose in fossilization their characteristic habit. A typical *Asterotheca* presents a radially symmetrical compression indicating a synangium with a comparatively much shorter long axis.

It should be emphasized that I do not in any way criticize Radforth's removal of *A. parallela* from *Dactylotheca* nor his masterly demonstration of the true morphology of the spore-bearing organs. I do feel, however, that the course fol-

lowed by that writer and by Hirmer lends excessive flexibility to the concept of *Asterotheca*.

Acknowledgment.—

The investigations reported here have been made possible chiefly through the generous cooperation of Mr. John E. Jones. I am deeply grateful for his continued support and enthusiastic interest in our studies. To the other employees of the Old Ben Coal Corporation who have extended aid I wish to extend sincere thanks.

My collecting trips to the Old Ben Mine have all been in company with Dr. James M. Schopf, now of the United States Bureau of Mines, and to him is due a very large share of the credit for such results as have been obtained thus far. The fine cuticle preparations illustrated on pl. 11, as well as the text-figure, were prepared by Dr. Schopf, and I am indebted to him for a considerable portion of the description of the sterile *Pecopteris* foliage. It should be noted, however, that the author assumes all responsibility for any of the theoretical views presented.

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Explanation of Plate

PLATE 10

Senftenbergia plumosa (Artis) Radforth var. *Jonesi* Andrews

Fig. 1. Photograph of the entire specimen; x 7.

Fig. 2. A portion of one of the pinnae magnified to show the abundance of sporangia; x 11.

Fig. 3. A portion of a pinnule showing the marginal position of the sporangia; x 20.

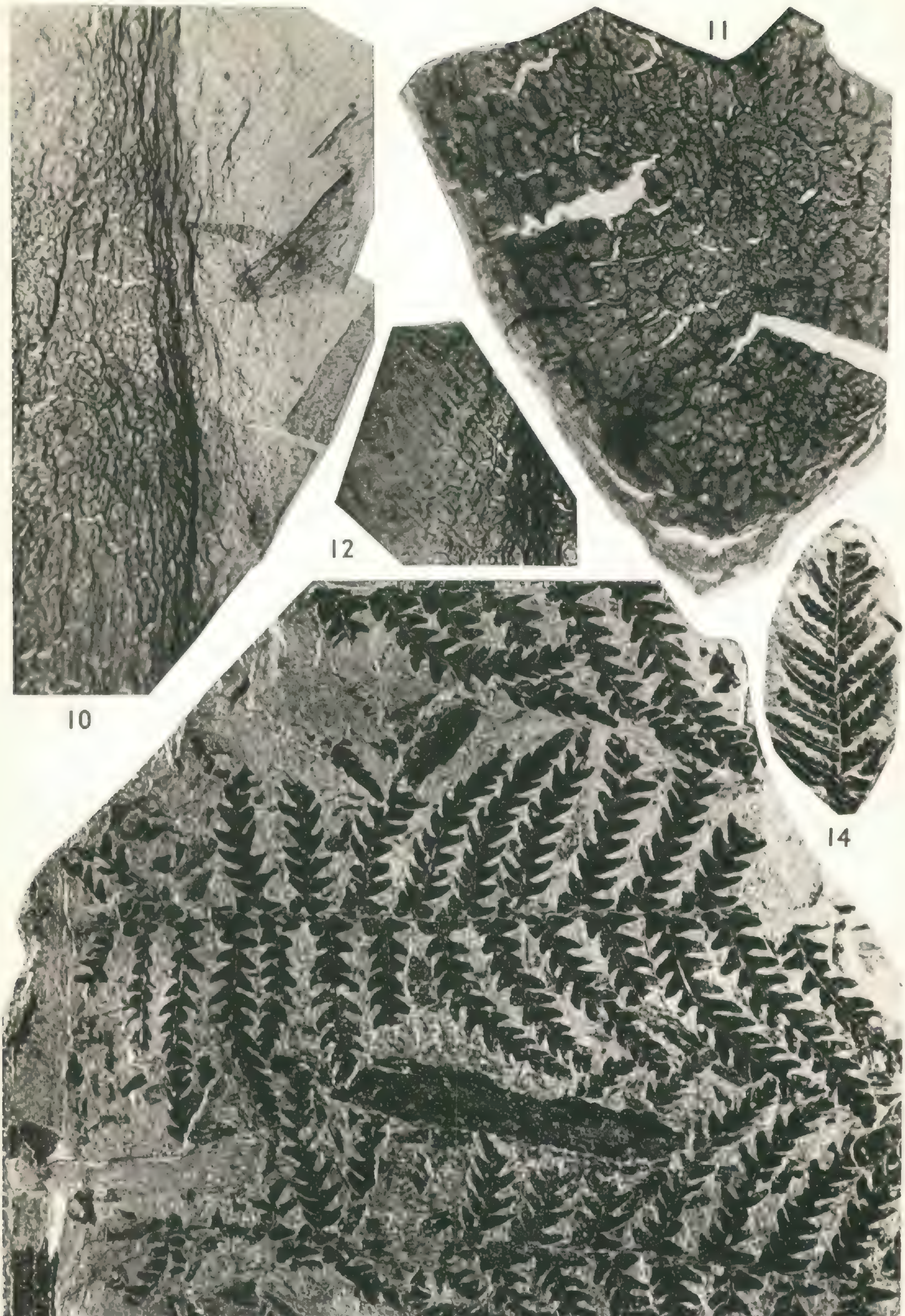
Figs. 4, 5. A single sporangium shown under different lighting conditions to bring out the cellular details of the wall; x 110 and x 80 respectively.

Fig. 6. A hair showing the characteristic septate structure; x 440.

Figs. 7, 8. Sporangial masses as they appear after partial oxidation of the sporangium wall; both x 150.

Fig. 9. A single mature spore; x 440.

ANDREWS—AMERICAN CARBONIFEROUS FLORAS. VI



ANDREWS—AMERICAN CARBONIFEROUS FLORAS. VI

Explanation of Plate

PLATE 11

Pecopteris plumosa var. *dentata* (Bgt.) White

Fig. 10. Cuticle; central heavier band represents the leaf margin, the dorsal (lower surface) cuticle is adjoined on the right. x 140.

Fig. 11. Ventral cuticle from the area between the branches of a bifurcated lateral vein; x 140.

Fig. 12. Dorsal cuticle at leaf margin; marginal zone at the right; x 140.

Fig. 13. Portion of a frond showing the primary rachis at the left and parts of three secondary pinnae; natural size.

Fig. 14. Pinnule of more delicate structure; x. 7.

Explanation of Plate

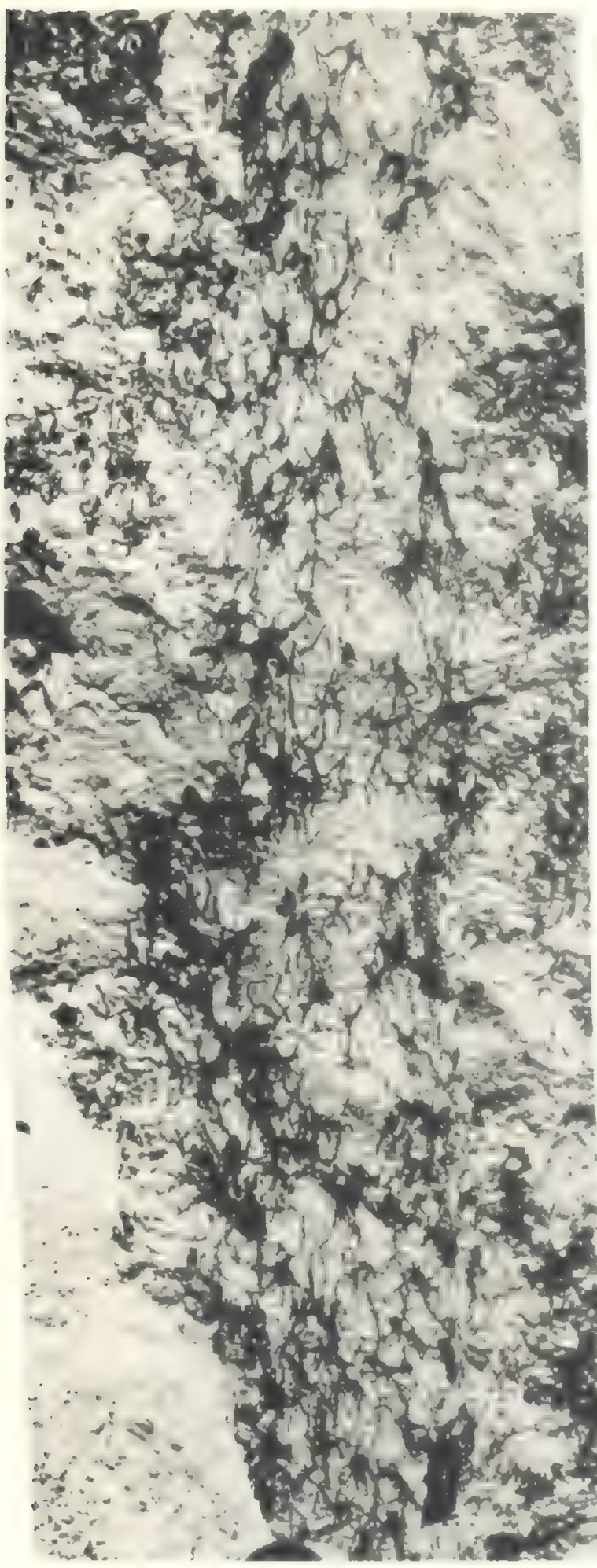
PLATE 12

Senftenbergia plumosa var. *Jonesi*

Fig. 15. Portion of pinna rachis showing the epidermal hairs; x 6.
Fig. 16. Apical portion of a sporangium; x 95.
Fig. 17. Branching epidermal hairs; x 440.

Scolecopteris Radforthii

Fig. 18. Portion of an ultimate pinna showing venation of the pinnules; x 10.
Fig. 19. Lower surface of a pinnule showing the compressed synangia; x 20.



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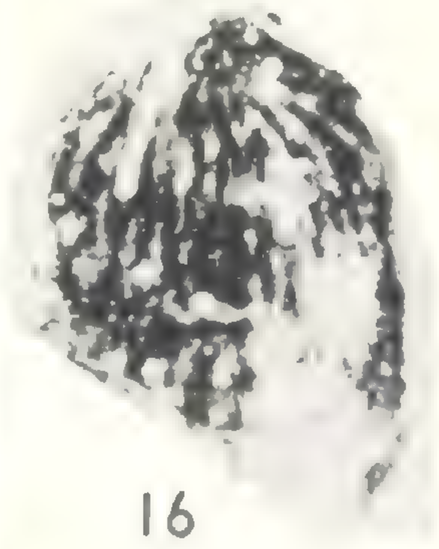

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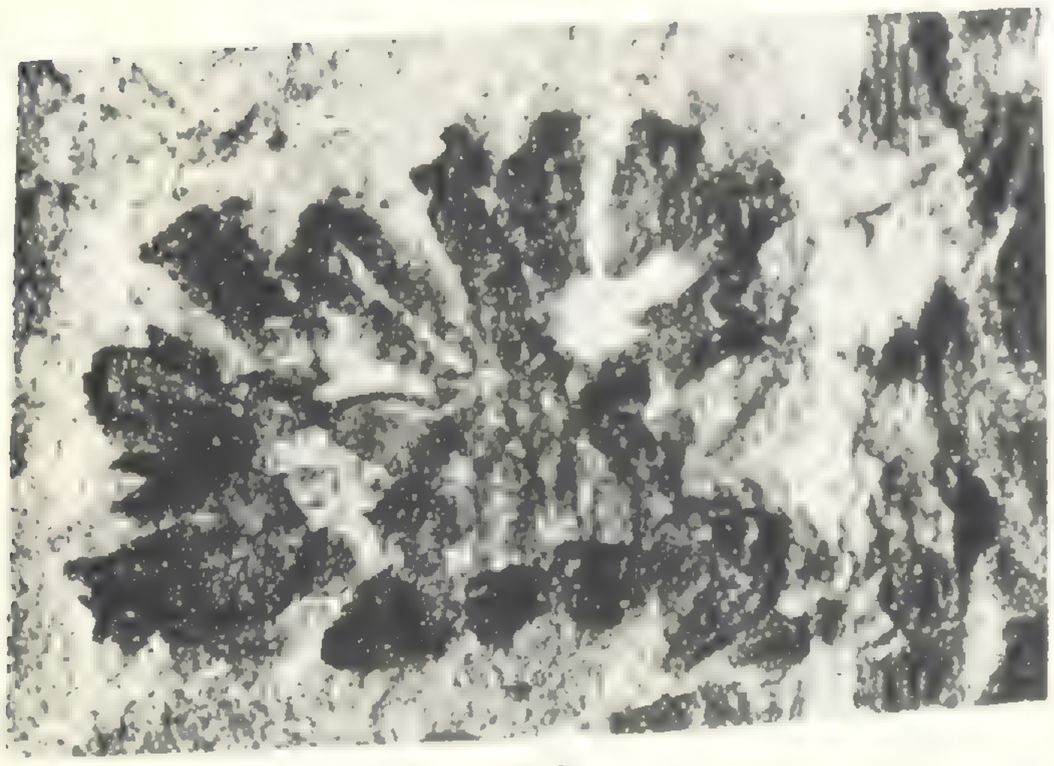

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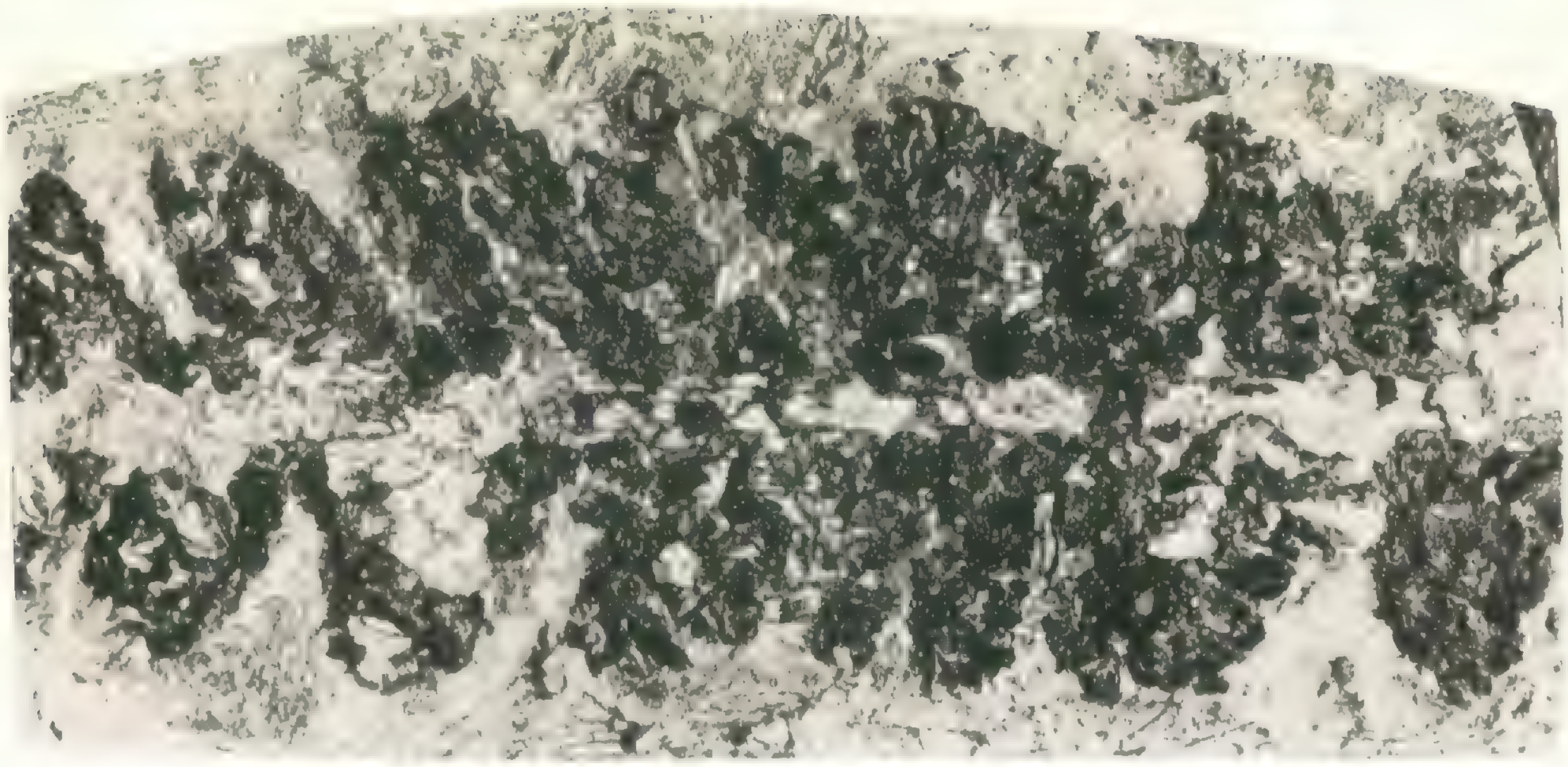

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ANDREWS—AMERICAN CARBONIFEROUS FLORAS. VI

EXPLANATION OF PLATE

PLATE 13

Scolecopteris Radforthii

Fig. 20. Portion of an ultimate pinna; x 10.

Fig. 21. A partially macerated synangium showing two spore masses and part of a third; x 135.

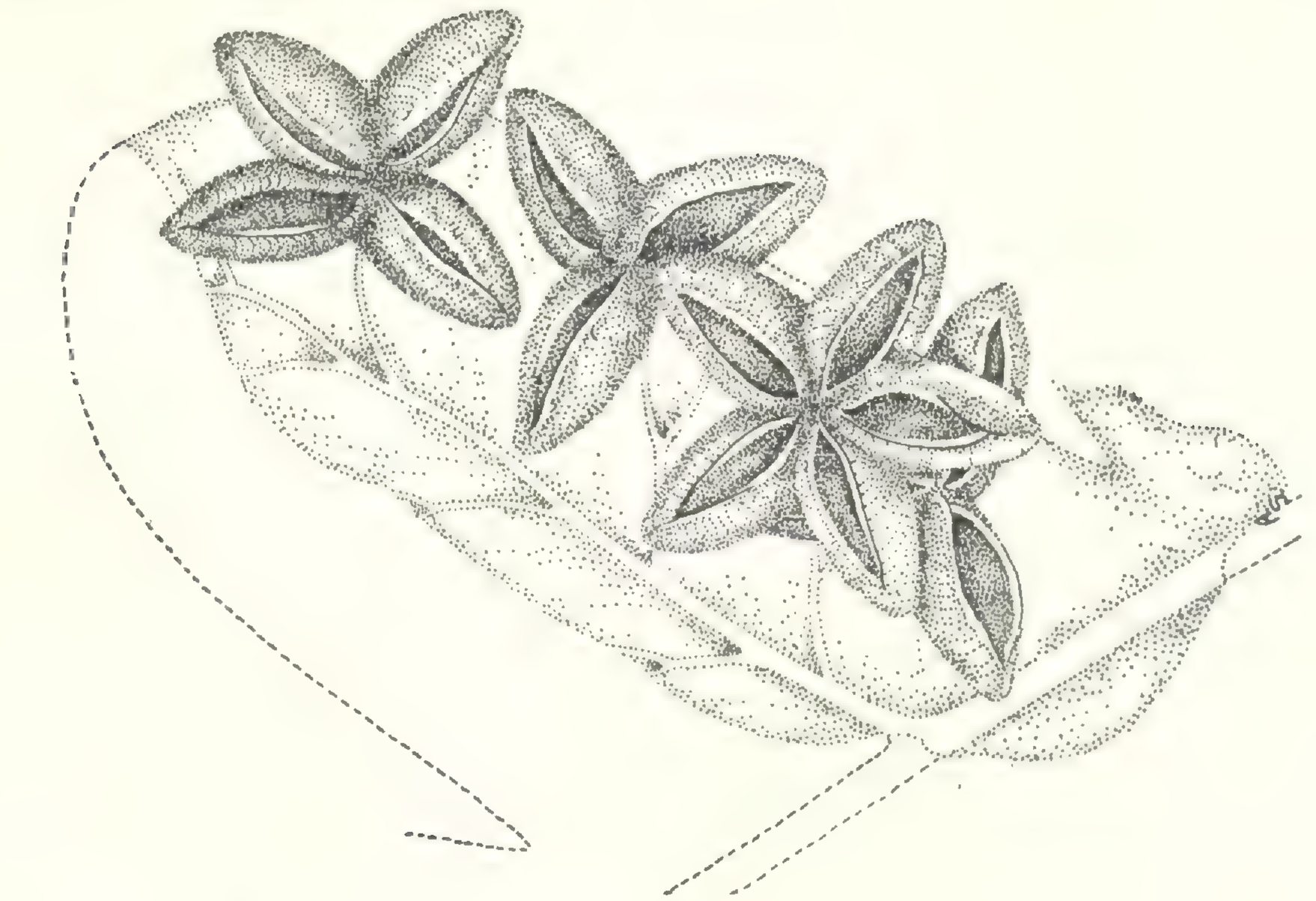
Fig. 22. A single isolated spore mass; x 135.

EXPLANATION OF PLATE

PLATE 14

Scolecopteris Radforthii

Figs. 23, 24. Showing the synangia before and after dehiscence.



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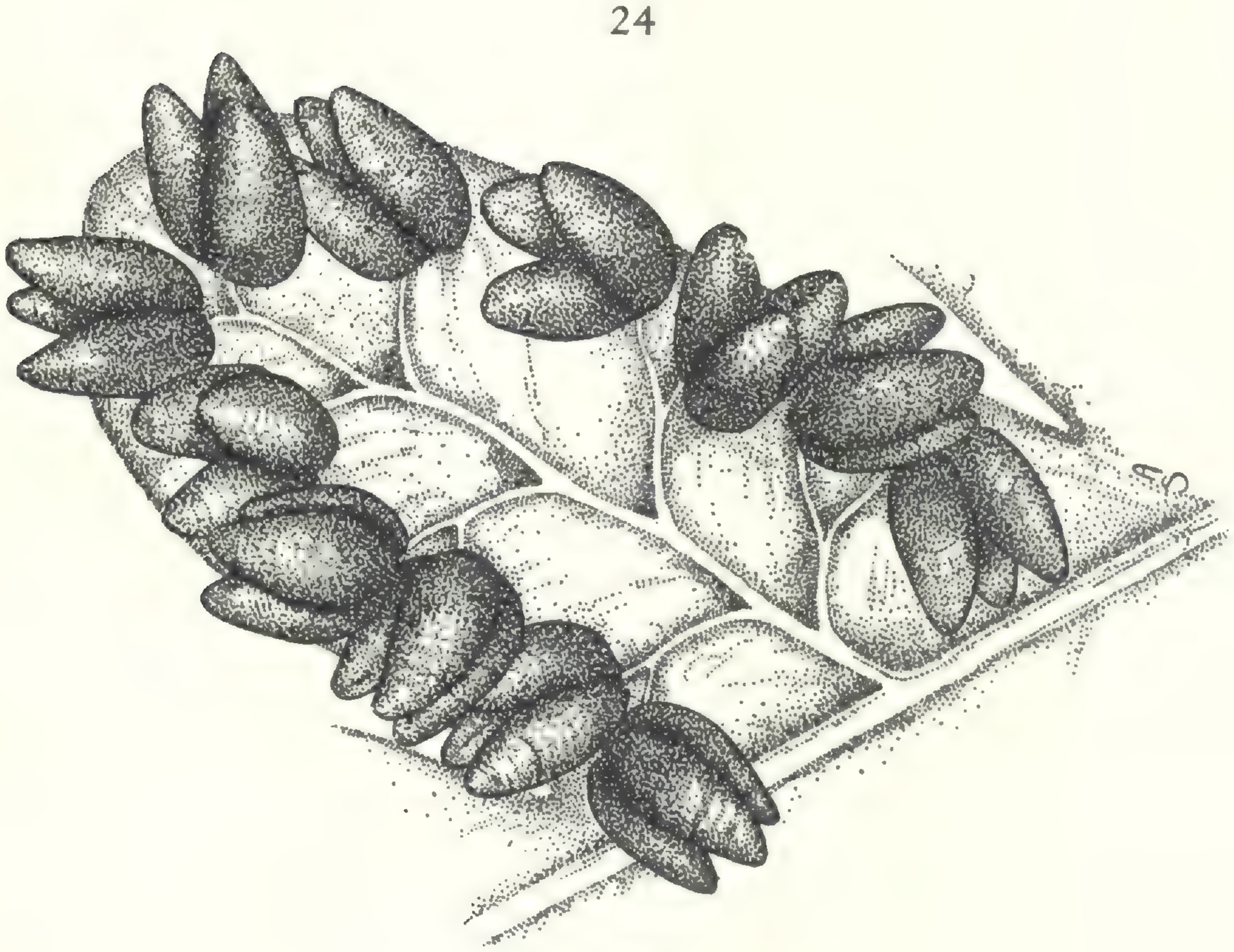

23

SOME HOURLY OBSERVATIONS OF TREE GROWTH

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Although everyone has observed the active response of trees to the seasons, yet trees are often thought of as static organisms,—capable, it is true, of performing certain functions in certain seasons or even remaining quiescent during the cold of winter but without the capacity of immediate adjustment to slight changes in environment. The habit of producing leaves in spring is generally associated with the increasingly warmer and brighter sunshine of that period. Likewise, the unfolding of flowers, the development of fruit, and the autumnal coloration are dependent upon seasonal changes in weather. These reactions are annually observed and appreciated. It is not generally known, however, that the duration of sunshine for any one day may require a profound adjustment on the part of the tree.

Numerous investigations have been made on the effect of environmental conditions upon tree growth. The literature contains many references to the response of trees to one or more meteorological phenomena. However, all the factors which have an effect upon the growth rate have not been studied simultaneously, nor have continuous and automatic records of them been made.

This study was undertaken to determine, if possible, the effect of weather upon the physiological processes of a tree. Since most physiological activity is finally manifested as growth, it was believed that a continuous record of growth—known to be of seasonal occurrence—might be correlated with the prevalence of certain external factors exhibiting similar periodicity. Thus, the conditions peculiar to early spring (abundant moisture, low temperature, short days, etc.) might show a correlation with the beginning of growth, or with its gradual decline upon the approach of summer. After the growth peak had passed other conditions would prevail (those of late summer, for instance, with longer days, less moisture and higher temperatures); and again a continuous record might show certain physiological relationships which in turn would differ from those of winter. Thus if the entire range of temperatures, seasonal amounts of sunshine and of precipitation are checked against the carefully recorded responses of the tree, certain individual and combined influences of these environmental factors might be reflected in its growth. The work herein outlined is intended as a preliminary report. Since identical weather conditions are of infrequent occurrence, many of the recorded relationships of these factors to tree growth have not been repeated, and the following discussion is based largely upon extreme conditions.

A critical study of tree growth must take into consideration both the systems of photosynthesis and translocation peculiar to trees. While this study does not specifically touch upon either system, the interpretation of the accumulated data

might have a bearing upon these problems. Since Curtis[1] has exhaustively discussed the literature and indicated the present status of the work while Gibbs[2] has cited an additional several hundred papers, no further bibliographical references will be made in the discussion to follow.

For this study a Bur Oak (*Quercus macrocarpa* Michx.) 34 years old was selected. This tree grew near the center of a small group of mixed White and Black Oaks and had received little pruning. The growth rate had been normal and as it had never been suppressed the tree developed a low wide-branched crown with a trunk 30 inches in diameter, 1 meter above ground level. Every effort was made to permit the tree to grow independent of any artificial stimulus, and throughout the period of observation it received no pruning, spraying, fertilizing or irrigation. This report covers a period of 70 weeks, from July 16, 1933, to November 25, 1934.

METHODS

During this investigation the dendrograph record was used as a basis for evaluating the effects of all the environmental factors. All external conditions which appeared to exercise some influence upon the growth of a tree were charted. Thus a continuous and automatic record was made of the air temperature, relative humidity, hourly wind movement, barometric pressure, precipitation, sunshine and soil temperature. Simultaneously, identical graphs were made of the expansion and contraction of the trunk by the use of the dendrograph, while the internal temperature and internal pressure were recorded automatically.

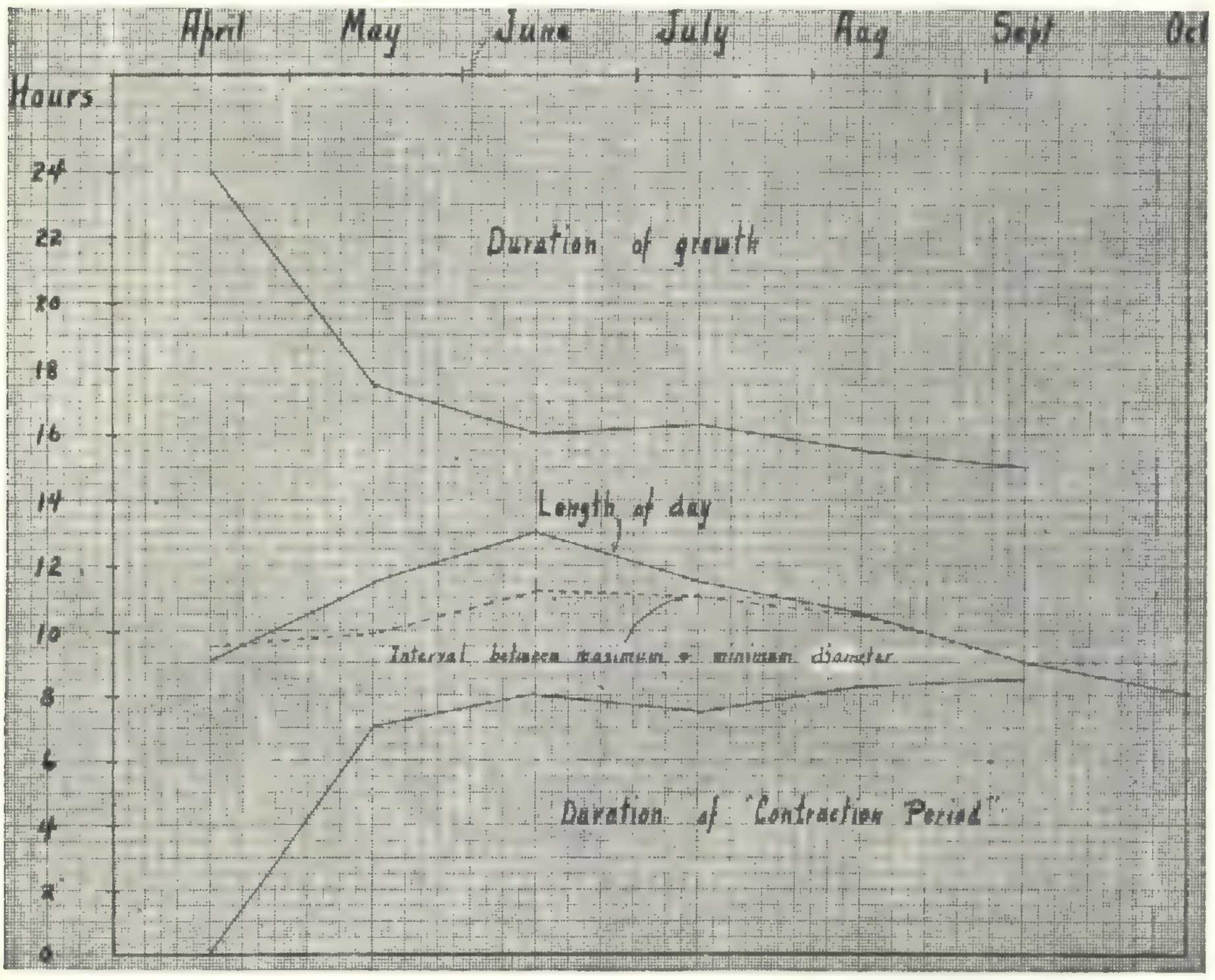
Since most of the instruments must of necessity be placed close to the tree under observation, a rectangular concrete block weighing approximately .95 kg. was cast within .3 dm. of the trunk to serve as a table. A shed 3 m. long, 1.3 m. wide and the same in height was built to enclose both the lower portion of the tree trunk and the concrete table. This shed was fitted with two large ventilators, one in the roof and another in the west side. The east side opened into a door, and the side walls extended to within 2 dm. of the ground level. This type of construction provided safety and shelter for the instruments during inclement weather, and at the same time allowed ample ventilation for accurate records. The sun record was taken on a roof several hundred meters from the tree. The barometer was located in a building approximately the same distance away. The hourly wind movement and precipitation records are from the St. Louis Office of the Weather Bureau, located about 7 km. from the tree. All other instruments were placed in the house built about the tree.

DENDROGRAPH

This instrument was developed by MacDougal[3], who has also carefully de-

[1] Curtis, O. F. The translocation of solutes in plants, New York, 1935.
[2] Gibbs, R. D. Studies in tree physiology I. Can. Jour. Res C 17:460-482. 1939; II. C 18:1-9. 1940; III. C 20:236-240. 1942.
[3] MacDougal, D. T., J. B. Overton, and G. M. Smith. The hydrostatic-pneumatic system of certain trees: movements of liquids and gases. Carnegie Inst. Washington Publ. 397. Washington, 1929.

scribed it and calculated its accuracy. It is capable of providing a continuous and accurate record of all tree-trunk fluctuations. Changes in diameter of a tree trunk being essentially manifestations of growth, the dendrograph becomes the most important instrument in a study of growth and the factors affecting it. For this study it was attached in the usual manner. The contact points touched a smoothed portion of the trunk, on opposite sides, about one meter above the ground. Since the contact rods touched the newer layers of the phloem the record is essentially a measurement of the actively growing portion of the tree. What influence external conditions have upon the xylem alone cannot be determined from this record.



Relation of daylight to tree growth.

In spring, about ten days after the initial swelling of the buds but before they reach 1½ inches in length, the dendrograph shows a marked daily rhythm in expansion and contraction. The peak of the expansion is reached between 4 A. M. and 6 A. M. At exactly 6 A. M.—on sunny normal days—the trunk begins to contract, reaching its smallest diameter for the 24-hour period at 4 P. M. From then no change occurs until exactly 6 P. M., when the expansion begins and continues until the following morning at 6 o'clock. This rhythm is constant on clear days when the tree is in leaf. However, during rain—no matter how slight

—and on cloudy or humid days the rhythm is temporarily interrupted. At such times the tree fails to contract in the period from 6 A. M. to 4 P. M. Should only a part of the forenoon be cloudy and the rest with full sun, contraction may begin later and last only a short time. Even the normal expansion, which begins at 6 P. M., may be delayed until midnight or after and it may continue until noon of the next day. This variation of the normal rhythm is only temporary, however, and the first cloudless day usually establishes the daily expansion and contraction. The degree of expansion and contraction and the length of the quiescent period, after attaining either the maxima or minima, are dependent entirely upon the sunshine and the relative humidity. Thus a cloudy day in midsummer shortens the contraction period as much as three hours; the minimum may be reached at 1 P. M. During that same morning the contraction period may have been delayed two hours; or until 10 A. M. Since the dendrograph record indicates that a certain amount of the daily expansion is dependent upon water absorption, the contraction must be the result of water loss. In this manner, the daily growth is obscured except as it shows in the slowly rising peaks of the dendrograph record.

All growth in diameter occurred between April 10 and June 7, a period of ten weeks. No growth is evident in the record after June 7, although this is the period during which the "summer wood" is usually expanded. The fact that during cloudy humid weather, in the absence of any notable contraction, there still exists a rhythmic increase in diameter, seems to indicate that whatever growth occurs is accomplished after midnight, the period during which this increase is normal. If the rhythmic diameter changes are accepted as indications of water loss or absorption, then the dendrograph clearly shows how minute is the lag between utilization and replenishment. The dendrograph reflects the condition of the cells adjacent to the point of contact on the trunk, in this case a halfway point between utilization of the water by the leaves and replenishment which is the function of the roots. Therefore, the rhythmic contraction beginning at 6 A. M., when only the top of the tree is exposed to the full morning sun, indicates that the effect of evaporation from that part is almost instantly felt throughout the tree. The rhythmic diameter changes occur throughout both the growing and the summer periods. Approximately two weeks previous to the shedding of the leaves the dendrograph record becomes a straight line and remains so except for minor fluctuations correlated with the internal temperature. At this time the cooling effect of actively transpiring leaves gradually diminishes, and the internal temperature gradually rises until the typical dormant record is produced. This is unmodified by transpiration and fluctuates as widely as the air temperature. Thus a close study of both the dendrograph and the internal temperature records will reveal the approximate hour during which the formation of the abscission layer begins. It will also show the time required for this formtion to affect all the leaves, thereby designating the hour of dormancy. The reversal of this process—the change back to rhythmic fluctuations—will, during the following spring, designate the hour of awakened physiological activity.

During extremely cold weather, when the internal temperature is finally lowered to —7° C., the tree immediately contracts and remains contracted until the temperature again rises. The contraction during times of extreme cold is in a straight-line relationship to the internal temperature. After the initial sharp contraction at —7° C., the diameter of a tree varies exactly as the internal temperature varies.

INTERNAL TEMPERATURE

To obtain this record a soil-thermograph was inserted in a 20-mm. hole bored through the trunk to within 80 mm. of the opposite side. Afterward a plug of asbestos was rammed in, leaving only the flexible tube extending. The entire opening was then sealed over with an asphaltic compound.

During the dormant period the record taken by this instrument is simply a smoothed curve of the air temperature, exhibiting whatever lag the insulating efficiency of the tree trunk imparts. Usually the internal temperature remains about 8° F. lower than the maximum summer air temperature, but it never exceeds 86° F. so long as the tree is supplied with some soil moisture. During the winter the internal temperature remains about 5° higher than the minimum. There are, however, rhythmic variations of internal temperature which are correlated with periods of stormy and fair weather, as well as distinctive seasonal trends. During the period of growth and its cocomitant transpiration the record is closely linked with that of the dendrograph, the internal temperature being highest at the peak of expansion and coolest when the contraction is greatest. Incidentally, the peak of expansion and also of internal temperature occurs during the early morning hours, coincident with the lowest air temperature and the lowest evaporativity of the air for the previous 24 hours. There is a marked tendency toward higher internal temperatures, sometimes an immediate increase, following a rain during the growing period. Should either the precipitation or the accompanying cloudy weather last for 24 hours, the internal temperature slowly declines to a point well below the daily minimum. The initial rise is traceable to the lessened transpiration during the actual rainy period. The decrease below the daily low record seemingly is the result of the accelerated transpiration, since following a rain more water is available. After the initial rise the periodicity of the rhythm is reversed, the internal temperature varying inversely with the dendrograph until the stormy period has passed. The cool morning hours find the tree coolest. This would not be true when the air temperature dropped considerably after rains, for then the lowered air temperature, no doubt, is chiefly responsible. However, if evaporativity is closely related to air temperature a rise in internal temperature should follow such cool periods, since there would be less water loss from transpiration. In any event the individual effects of these phenomena cannot be separated, and in all probability both become operable under certain conditions and may mask their interlocking effects.

SOIL TEMPERATURE

The recording element of a soil-thermograph was placed 22 inches below the surface under the branch tips. This position was chosen after explorations showed the presence of a large number of "feeding" roots in this area. The soil surface around the tree and extending beyond the branch spread was without vegetation. During the summer the portion above the thermograph element received sun for only 1½ hours during the mid-day.

The record of the soil temperature discloses no great daily range, and the annual record appears as a smoothed curve of the internal temperature. In the absence of marked daily or weekly fluctuations, the effects of soil temperature could not be traced on the dendrograph. Thus, although this factor does not have an hourly effect upon the tree it probably does influence the seasonal occurrence of growth. In this connection it is interesting to note that all spring growth in diameter occurred within the comparatively narrow limits of 15° F. Growth began in April coincident with a soil temperature of 50° F. and ceased the first week of June with a soil temperature of 65° F. A maximum of 78° F. was reached in July; the minimum, 29° F., during the first week of March. Comparative figures of soil temperatures from more exposed situations are not available, but it is certain that they were higher during the dry spring and very dry hot summer. Whether the heat reacted unfavorably upon the trees is not known. The temperature recorded under the tree observed was probably not inhibitory to growth; insufficient water seems more likely to have been the limiting factor in the period after June.

PRECIPITATION

This record, as well as the wind record, was taken from the St. Louis Office of the Weather Bureau, a distance of about 7 km. from the tree. During most of the year duration of rain at the two stations is practically the same, and the total precipitation does not usually vary greatly. However, during the hot dry months of June, July and August, weather conditions may be altogether different at the two stations. It is during these hot dry spells that the effect of precipitation is most easily determined, and for that season the record is simply an observation.

Certain periods of the dormant season are generally considered as devoted to water storage. However, the effects of rain were noted only during the summer, when even slight amounts (.01 inch) were recorded by an upward rise in the dendrograph. The abruptness of the rise and its continuance depended entirely upon the total rainfall. Precipitation of only .01 inch was beneficial chiefly because of the humid conditions prevailing at the time. Much more rain was necessary to percolate sufficiently to reach the roots. The reaction to larger amounts of rain, which in 1933 and 1934 occurred only in very early spring, are not easily discernible. In spring, the tree is usually well supplied with moisture, since transpiration has not reached the peak of midsummer and temperatures are uniformly lower. Therefore, slight fluctuations in both the dendrograph and the records of

internal temperature cannot be interpreted as resulting solely from rain. It is hoped that future less droughty years will yield a record showing the effect of substantial rains in midsummer. During the fall of both 1933 and 1934 there was an abrupt increase in tree diameter coincident with the beginning of the seasonal rains. That this increase was not maintained may have been due to the extremely dry weather characteristic of the winter following. Other more favorable seasons might show the late September increase coincident with the fall rains to be of a permanent character. The absence of any marked diameter increase after rainfall, in either fall, winter or early spring is difficult to account for, since both water loss and gain, as well as growth, are charted in the dendrograph record and can be easily separated.

RELATIVE HUMIDITY

A continuous humidity record was obtained from a hygro-thermograph placed on the concrete block in the shelter previously described.

Throughout both the "growing" and the "summer" seasons, during clear weather, the humidity is highest between midnight and 4 A. M. Then it begins to decline and reaches the lowest point about noon. Changes in relative humidity affect the evaporating power of the air and consequently alter the transpiration rate, as is clearly shown in the dendrograph record. Both the humidity record and the dendrograph record show a peak in the early morning hours. The humidity declines first, and shortly after the dendrograph records a contraction of the trunk. Since the relationship between tree diameter and humidity is so close any factor capable of modifying the humidity will affect the tree sufficiently to be incorporated in the dendrograph record. On cloudy days, which are usually accompanied by higher and more nearly uniform humidity, the tree undergoes only a limited contraction. The more uniform dendrograph record continues as long as the humidity remains above that of normal bright days. During the cooler portions of late summer, the dendrograph shows a delay in the beginning of the contraction period coincident with the presence of dew. While the almost instantaneous responses of the tree to changes in relative humidity have been demonstrated, the fact remains that the daily period of contraction begins at 6 A. M. regardless of the average monthly humidity readings, which tend to decrease from April to July and to increase toward October. Thus the average monthly humidity readings for 1943 show:

	7 A. M.	7 P. M.
April	64%	57%
May	59%	43%
June	66%	49%
July	61%	42%
August	73%	59%
September	86%	72%
October	74%	54%

Since humidities do not tend to be lower in midsummer than during other growing seasons, seasonal shifting of contraction and expansion periods following

the daylight hours is not reflected in the humidity reading. Essentially, humidity changes affect the tree instantaneously and therefore show no seasonal rhythm.

WIND MOVEMENT AND AIR TEMPERATURE

These two factors show no seasonal trend. The wind movement remains nearly constant throughout most of the growing season. Its effect upon the tree is immediate, and we have observed a very rapid rise or fall in internal temperature due to accelerated wind movement prior to a thunderstorm. The air temperature gradually rises to a peak in summer and then declines. Apparently it has only a limited effect upon the tree, since any rise or fall in air temperature is usually correlated with certain very definite weather changes, and it would be reflected in other records.

BAROMETRIC AND INTERNAL PRESSURE

Certain of the hourly charts indicate an interesting relationship between barometric pressure and the behavior of the tree. However, the precise effect of a rising or falling barometer must be left to a subsequent study more concerned with a shorter time interval than used in this study. The internal pressure, an extraordinarily interesting measurement of the activity of a tree, has been reported upon.[4] These two factors are again without seasonal trend, and since their effect upon the tree is instantaneous, the records obtained must be read to a very short time interval, perhaps 5 minutes or less.

SUNSHINE

The length of day, changing as it does from season to season, might be expected to exert a profound influence on the behavior of a tree. That it does is apparent from the dendrograph record and also from the internal temperature. In April the interval in the daylight hours between maximum and minimum diameter is only 9 hours, in May it is 9.9 hours, and in June, with 13 hours of sunshine, it increased to 11.3 hours. This means that as the sun rises earlier toward the latter part of June the tree begins to shrink early in the morning and reaches and maintains its small diameter later in the day. During this early period, when active growth is taking place, the effect of sunshine is very marked, although the contraction or expansion of the trunk is not as closely tied to length of day as it is through the months of August and September. During the late fall contraction begins with sunrise, and expansion begins with sunset. It is known, however, that in addition to seasonal trends sunshine does cause an immediate change in the activity of a tree. Some evidence exists to show that the passing of each cloud on an otherwise clear day modifies the functions of the tree to the extent that they can be recorded. Thus the dendrograph and the internal temperature readings both leave a record indicating the passing of a cloud. The immediate effect of

[4] Beilmann, August P. An attempt to record internal tree-trunk pressures. Ann. Mo. Bot. Gard. 27:365-370.

sunshine on a tree will be the subject of later investigation. As a general thing, a bright sunny day accelerates transpiration, depresses the internal temperature, and initiates the beginning of the contraction period.

SUMMARY

Several thousand weekly charts have been obtained from a series of automatic recording instruments. These show some interrelationship between "weather" at a particular hour and some modifications to it on the part of the tree, depending upon whether or not the external factor favored or inhibited growth.

The dendrograph has proven of value in recording seasonal trends but some modification of the instrument is required for a critical study of tree behavior.

The internal temperature shows a seasonal trend but is equally important for a short-time study. It is rather difficult, however, to localize the reading and in this study the average of the trunk diameter was obtained.

The soil temperature is a seasonal factor playing a role at the beginning and perhaps at the end of the growing season.

Precipitation, as might be expected, is seasonal and exhibits a pronounced effect very quickly when it occurs out of season. A calculation from October to October probably gives a clearer picture of the moisture need and utilization of the tree than does a record based on the calendar year. During a very dry portion of the year the tree immediately reacts to any form of moisture whether rain, dew, or high humidity.

The hourly wind movement and the maximum wind velocity are without seasonal effects. Wind cannot be dismissed, however, since observation has shown a striking relationship between velocity and internal temperature.

The air temperature varies with the season, and does not show either marked seasonal trends or rapid effects, largely because all other factors are changing just as rapidly. For instance, since a very sharp rising or falling temperature may be accompanied by rain, on the one hand, and a dry period, on the other, the effects are lost in the other records.

The barometric pressure and the internal pressure might be expected to yield some interesting records. However, the effects seem to be lost in any seasonal study of behavior. They may be investigated in a study dealing with a short-time interval.

SEGREGATION, MUTATION, AND COPULATION IN SACCHAROMYCES CEREVISIAE[1]

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HAPLOPHASE CULTURES

Some individual ascospores from 4-spored asci of *Saccharomyces cerevisiae* germinate to produce haploid cells which persist in the haplophase, thus producing entire cultures containing only haploid cells. We ('43c) have reported a new method of hybridizing yeasts by mixing haplophase cells of different origin in broth. The mixtures result in copulations between different haplophase cells if each culture is paired with its complementary type. The diploid hybrid cells produced by copulation are capable of forming asci containing 4 viable spores.

Šatava ('18) and Winge and Laustsen ('37) showed that some of the single ascospore cultures from many recognized species of *Saccharomyces* contain only round, or roundish, rather small, haploid cells. They observed these cells fuse in some cultures to produce dumbbell-shaped zygotes from which elongate vigorous diploid cells arose by budding. These investigators all agree that such haploid cultures are obviously the equivalent of *Torulae*[2], and Winge and Laustsen attempted pairings of the standard species of *Torula* which were available in Copenhagen. They remarked, "In no instance did the pairing inoculations give rise to ascus formation. But this negative result was really to be expected as all Saccharomycetes appear to be asexual or homothallic." Their conclusions may be influenced by the fact that they observed copulations between haploid cells and ascospores in preparations held between slide and cover-glass so tightly that the cells spread out in two dimensions only. This gave beautiful photographs but may not have permitted sufficient freedom of contact to make preferences in copulation obvious. Our conclusions were based on genetical analyses rather than microscopic observations and were confirmed by controlled matings of haplophase cultures. They made no attempts to pair the haplophase cultures which they obtained from *Saccharomyces*. Šatava observed that ability to sporulate is restored by fusion of haplophase cells but apparently he made no direct efforts to pair haplophase cells from different cultures.

Winge and Laustsen considered the haplophase to arise by standard reduction and segregation of a diploid nucleus in the conventional manner (which seems to

[1] This work was supported by a grant from Anheuser-Busch, Inc., Saint Louis.

[2] From a strictly taxonomic point of view, the name "*Torulopsis*" should be used, for *Torula* had already been applied to another genus when it was first suggested by Hansen. However, since Hansen and all other investigators of industrial yeast have used "*Torula*", we are following their example in this article.

us the most acceptable view), while Šatava is rather vague about the relationship of haplophase and diplophase. Šatava found these "reduced" (haplophase) forms much different from standard diploid yeasts in their ability to produce spores and "die Zellen von normalen Form zu bilden." He attempted a classification of the degree of deviation of the haplophase from normal which agrees generally with our own observations. Winge and Laustsen were much more precise, and probably more accurate, in distinguishing between haplophase and diplophase. They observed the diplophase to originate either (1) by direct germination from a single, originally haploid, ascospore (text-fig. 2) or (2) by the delayed fusion of two haploid cells arising from the same haploid ascospore. In the former case, the nucleus in the originally mononucleate spore divided to produce two nuclei which fused in the new bud. They found cultures originating by direct diploidization to be degenerate in many ways, and this fact has been confirmed in our experience. We have observed that when a haploid ascospore germinates directly as a diploid cell to produce a small colony, it often dies before transfer can be made. On the other hand, when a single-spored ascus from a diploid colony germinates, it usually grows out directly as a diploid cell and is apparently fully vigorous and identical with the original form. In this case it seems probable that the original spore was diploid rather than haploid.

The first two types of diplophase cultures arising from haploid single ascospores are homozygous. Winge and Laustsen observed that homozygous diplophase cultures vary extremely in their ability to produce spores, and that the spores produced are generally of diminished viability, facts which we have confirmed. They stated that the haplophase never produces spores, but to this we have found some rare exceptions. However, the spores produced by the haplophase are much inferior in vigor to those arising from the diplophase. For example, one of the variants of the round-celled haploid culture *A*, described below, produced spores in round asci the same size as the vegetative cells, thus proving that the spores had arisen parthenogenetically. Four intact 3-spored asci and eight single ascospores from two 4-spored asci were isolated on nutrient medium and failed to produce viable cultures.

The simplest criterion for distinguishing haplophase from diplophase is difference in cell shape and size. This is not a perfect method although the large ellipsoidal true diploids are easily distinguished from the small spherical true haploids. However, some haploid cells are regularly elliptical but smaller than the corresponding diploid and there are many intermediate types. Inspection of many cultures has confirmed the view that many single ascospore cultures are haploid and remain haploid. Haploid cultures are much more variable than diploid cultures. Several rough variants practically always appear when a suspension of haploid cells is plated on an agar surface. Winge and Laustsen remarked on the fact that haploid colonies contain many sectors; that they are generally smaller than diploid colonies has been observed by Winge and Laustsen, and Šatava, an observation which we have confirmed. Variation in shape of cells also occurs, and

haploid colonies originating from small spherical cells often contain large numbers of balloon cells and long slender fibrous cells. Old broth cultures contain cells described as "ameboid" by Šatava. He doubtless had these characteristics in mind when he stated that the extreme reduced forms were unable to control cell shape. According to our interpretation these so-called ameboid forms in old broth cultures are copulating cells. The variability of colonial forms in haploid cultures is due to the fact that recessive mutations occurring in the haplophase are immediately revealed in the phenotype. A diploid culture may be equally mutable but the "opposite number" normal allele is dominant and the mutation does not come into expression. The mutated genes present in a normal, smooth-colonied, wild-type, diploid cell are revealed when four spores are dissected and each is grown separately. Almost invariably none resembles the parent culture.

THE "ROUGH" CHARACTER

The most useful diagnostic character differentiating various haplophase cultures is the so-called "roughness" of the colony grown on solid medium. The tendency to classify yeasts as "rough" or "smooth" is not a fruitful approach to the subject. Smoothness is the wild-type character which distinguishes the form capable of successful competition under natural conditions. It depends on the fact that the cells do not cohere to form a specific pattern, but daughter cells separate quickly from mother cells and each new unit falls smoothly into place making the colony a round hemispherical structure on the solid substrate. Roughness depends on the cells clustering in such a way that a definite pattern results when the macroscopic colony reaches its full growth. The basic pattern of aggregation is observable in microscopic examination of the cells from broth cultures, for rough types generally bud in various "rosette" forms.

Winge ('35) has described the "figure 8" arrangement of haploid cells prior to copulation (text-fig. 2). After a bud has reached full size, two new buds appear (one from the mother and one from the daughter cell) near the point of union of daughter and mother cell, producing a "4-leaf clover" effect. Most "rosettes" originate in a variation of the "figure 8" formation. Many of these cultures make what appears to be homogeneous suspensions because the "rosettes" are too small to affect the turbid appearance produced when the culture is suspended in fluid medium or grown on broth, but the extremely rough colonies cannot be easily brought into a homogeneous suspension and when rough-type yeasts are grown in liquid medium the supernatant liquid is completely clear. This is a character much desired for wine yeasts, especially for champagne yeasts. There is a basic pattern of cohesion even in extremely smooth cultures, for nearly all colonies show some distinctive topographical structure if grown on solid medium long enough to form a giant colony. Conversely, when moderately rough colonies are sown heavily enough on agar to prevent the formation of large colonies, only smooth ones appear. On an unevenly spread plate one finds an outer fringe of extremely rough, large colonies surrounding a central group of small,

smooth ones. All belong to the same genotype but the rough character cannot come into expression until the colony attains considerable size.

We have observed several hundred different types of rough-colonied yeasts, and although each one is distinctive and recognizable and can be duplicated and recognized when transplanted, we have not thus far discovered any exact duplicates. The range of variation is extremely great. In addition to the fundamental "rosette" or budding pattern, differences in shapes and sizes of the cells affect the colonial form. In all colonies the variation in cell size increases with age, generally in the direction of producing larger cells. As a rule, rough colonies contain more elongate cells than smooth colonies, and part of the basis for extreme roughness is possibly the maintenance of end-to-end connections after cell division which has been described so frequently in the genus *Bacillus*.

All four cultures from the single ascospores isolated from a 4-spored ascus originating from stable, smooth-colonied, wild-type diploid cultures of *Saccharomyces cerevisiae* are usually rough-colonied. This proves that the genes differentiating rough from smooth colonies are recessive and several loci are involved. The wild-type "opposite number" alleles of the mutant genes prevent them from coming into expression in the heterozygous wild-type diplophase. Although we have dissected many asci from the same diploid culture, practically no duplicate cultures have been found among the colonies grown from the single ascospores, which indicates that the diploid cell is heterozygous for a considerable number of mutant genes and that many loci affect the characters lumped into the so-called "rough" class.

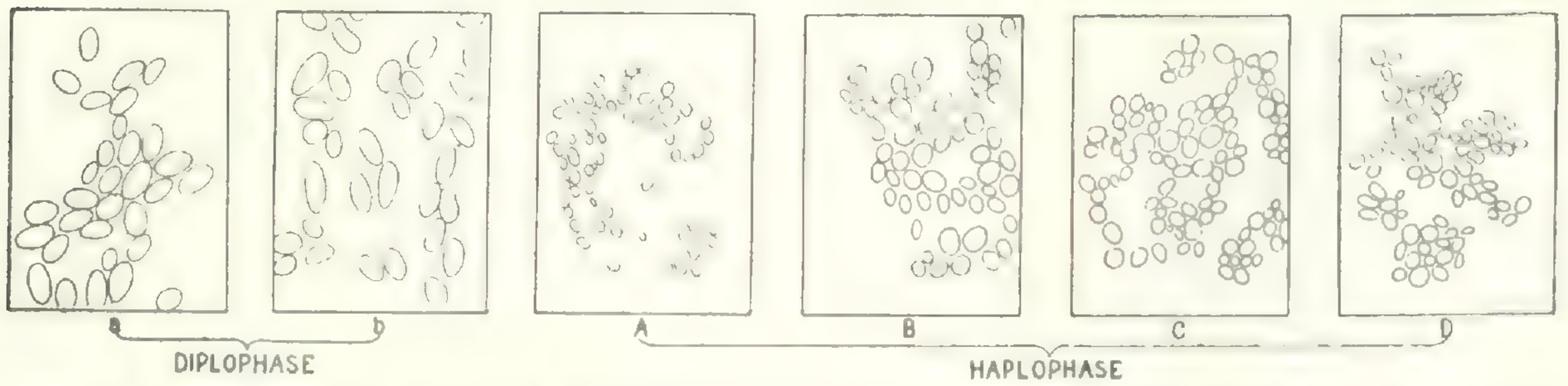
SEGREGATION AND MUTATION OF HAPLOID CULTURES

Plate 15 shows photographs of four single ascospore cultures isolated from a single ascus of the M strain. They are all in the haplophase. Usually some of the single ascospore cultures from one ascus are diploid, but we have not found any regularity in the distribution of haplophase-diplophase types indicating that the character is the result of interaction of several genes. The data presented here are merely part of an extended pedigree of the M strain, but since no new points beyond those already recorded in earlier papers were established the entire pedigree is not reported. The ascus mentioned above was derived from an inbred culture. In the inbreeding process an intact 4-spored ascus selected from the original M strain was isolated and formed a colony. This colony was plated on agar and a single colony from this plate was selected and induced to sporulate. An intact 4-spored ascus was again selected from the best sporulater, grown alone, induced to sporulate, and an ascus from this second generation was the origin of the third-generation colonies shown in pl. 15.

Plate 16, figs. a and b, show the diplophase cultures obtained from the colonies grown from two intact 4-spored asci. A study of cell shape and size of the six cultures showed that the single ascospore cultures were haploid while the two cultures obtained from intact asci were diploid. Drawings of the cells on the same

scale are shown in text-fig. 1. The diploid cells are long and ellipsoidal in contrast to the round cells from the haploid cultures.

The colonies of the diploid cultures are uniform provided they are plated on agar before spores form spontaneously. If they are left a few weeks on an agar plate and then plated again on agar, variations appear due to the germination of ascospores which have formed in the colony. The large colony size is evidence of the vigor of the diplophase.

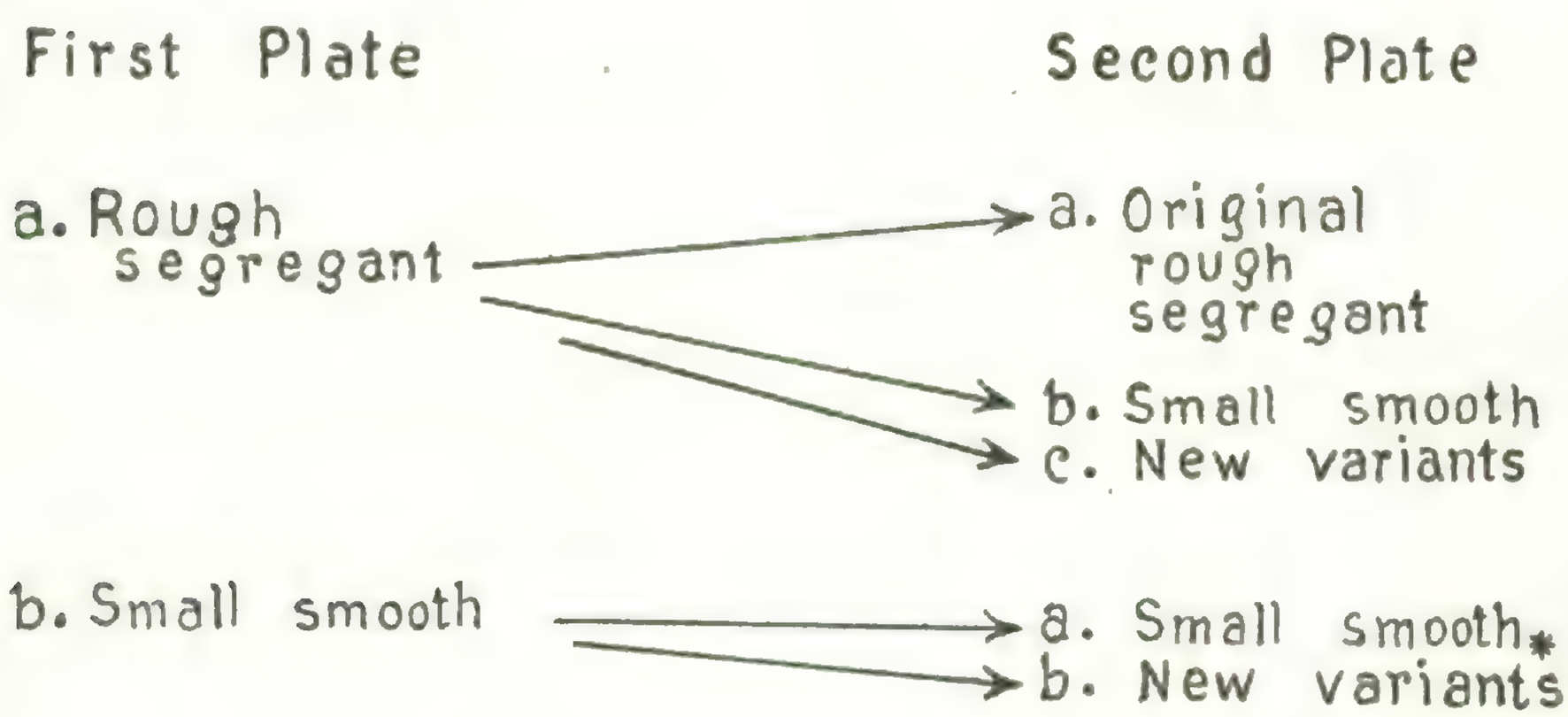


Text-fig. 1. Outline drawings (copied from photographs) of the cells from the six cultures shown in pls. 15 and 16.

The difference in colony type produced by the four haplophase cultures shown in pl. 15 are indications of the degree of heterozygosis of the diplophase from which they were derived. The original ascospores and the resultant colonies are designated *A*, *B*, *C*, and *D*. The different colony types are produced by segregation of genes at spore formation and multiplication of haploid cells, followed by mutation. These are the same cultures which were mated with each other in all combinations as previously reported (Lindegren and Lindegren, '43c). The earlier paper shows a photomicrograph of cell suspensions of the four cultures and reveals that the cells of the rough colony *(D)* produce "rosettes" characteristic of most rough colony types. Matings revealed that *A* and *D* belong to class a, while *B* and *C* belong to class *α*. Culture *A* is weakest and at the first plating produced only small colonies all of which were apparently uniform. However, in small colonies the phenotype is difficult to determine, since diagnostic characters are clearly shown only by relatively large colonies. On serial plating a large variety of colonies appeared. It does not seem profitable to report on these successive mutations since the data are simply a repetition of what has so frequently been described in bacteria. One fact was of interest, namely, that as selection and plating of colonies were continued, stable forms began to appear. These forms were all round-celled like their progenitors and therefore haploid. The weak culture *(A)* was more variable than the other three, and this is in line with observations on other strains, which indicate that a weak culture, once it is brought to a point of reasonably good growth, produces many more variations than stronger types—simply because the new mutations meet with less selection pressure from the mother colony type than in relatively more vigorous forms. As the *A* culture became better adjusted, by continued subculture, to the substrate on which it was plated, the variations became more obvious.

Cultures *B*, *C* and *D* show a characteristic feature of the more vigorous haplophase strains. The first plating generally shows a large rough colony accompanied by a smaller smooth form. (The cavities in the colonies reveal the places from which transfers have been made.) Transfer of the large rough colony produces the original rough type again accompanied by the small smooth form, with an occasional further departure in the shape of a new rough variant. This proves that the original rough type is the primary segregant while the small smooth form is a secondary mutation of the original segregant. This is further indicated by the fact that the small smooth form is much more stable than the original rough. Subculture of the smooth produces the smooth form almost exclusively, with only a few other variants which are often not generally comparable to the original segregant.

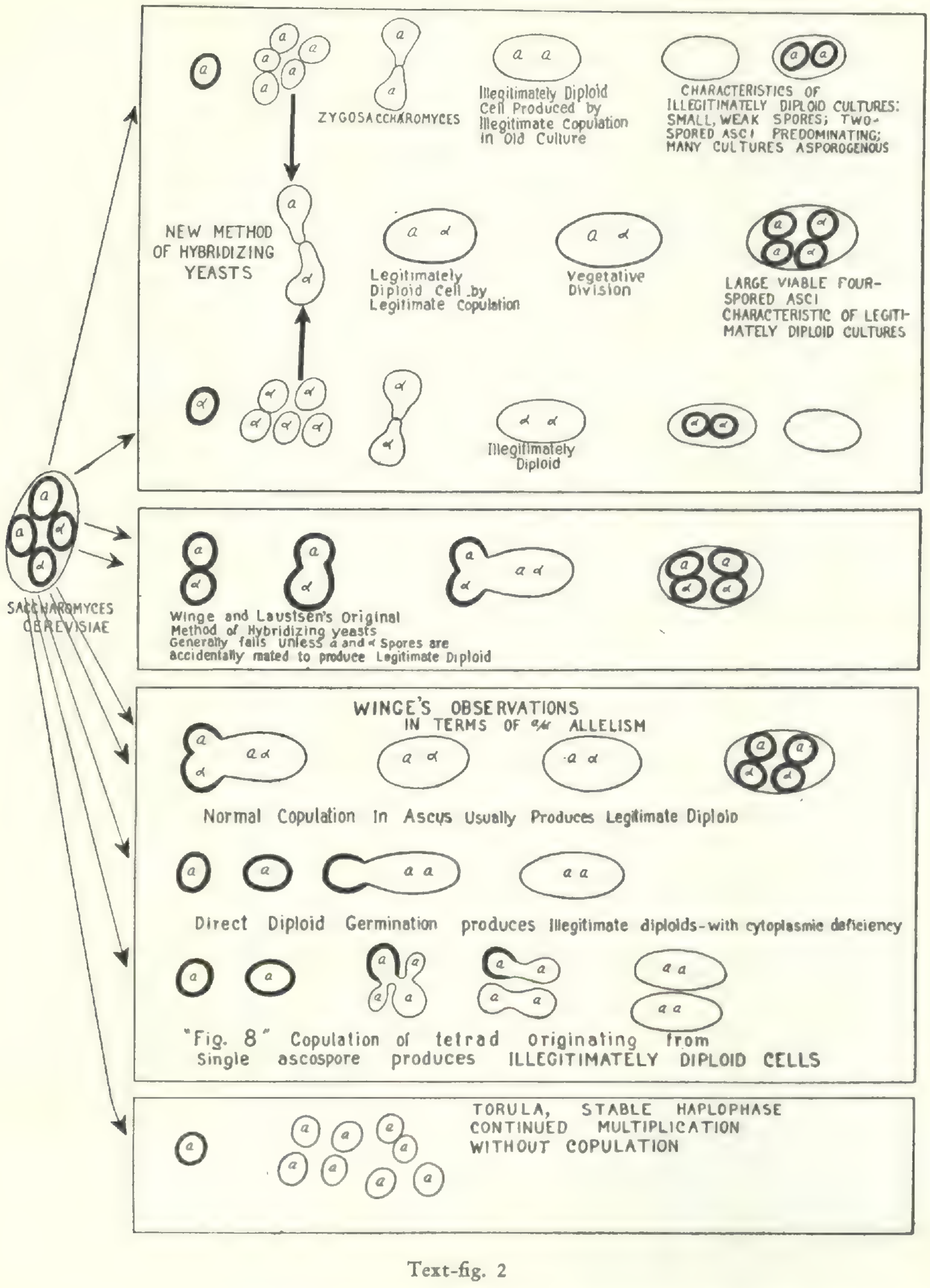
The sequence is as follows:



*These new forms are not generally comparable.

The four segregants shown in pl. 15 are characteristically different in colony shape and topography. The *D* culture is the roughest. The *C* culture produces the largest colonies and subsequent testing on a variety of sugars indicated that it was the best gas producer and the best yielder. The *A* culture, even after long subculturing, was much weaker.

Plate 17 shows the colonies of the four primary types obtained by subculture six months after the original isolation. The three photographs labelled "*A*" all show mutations of the *A* culture. Two of these are relatively stable while considerable variation is encountered in the third. The large colony size shows that some of these new variants have become fairly well adapted to the medium. The primary segregants from ascospores *B*, *C* and *D* are still rather clearly recognizable in spite of several serial transfers. They are generally much more stable than the *A* culture although many recognizable variants were obtained from each of them. However, so much variation occurred in the serial transfers of *A* that neither the original segregant nor the lines of descent can be traced.



Text-fig. 2

Life cycle of *Saccharomyces cerevisiae*, showing relationship with *Torula* and *Zygosaccharomyces*.

COPULATIONS BETWEEN HAPLOPHASE CULTURES OF SACCHAROMYCES CEREVISIAE

Haplophase cultures of *Saccharomyces cerevisiae* fall into two main groups which we have provisionally designated a and *a*. Each culture is made up of potential gametes which can be mated with other cells of appropriate genetic composition from another culture. As the pure haplophase cultures age, illegitimate copulations occur between two cells of the same reaction in the same culture, but these matings rarely result in the production of characteristically large diploid cells. Diploid cells produced by illegitimate copulations are easily distinguished by smaller size and diminished ability to produce 4-spored asci containing viable spores. Matings between a and *a* haplophase cultures derived from a variety of strains of *Saccharomyces cerevisiae* produce large diploid cells which sporulate to form 4-spored asci containing viable spores. The procedure is as follows: One cc. of malt-dextrose dried yeast broth is placed in a 6 x ¾-inch culture tube. A large loop of cells from a broth stock culture is introduced together with a second large loop from a different broth stock culture. The tube is kept overnight in the refrigerator at about 10° C. The next morning it is placed in the incubator at about 26° C. where it is held for 48 hours. Inspection at 24 hours incubation usually does not reveal any copulations; new copulations appear after 24 hours, sometimes rather abundantly. The reason for the small inoculation is that in old haplophase broth cultures one often finds abundant copulations. These cells do not generally survive on transfer to new broth but only the small haplophase cells propagate the culture. If large amounts of cells are mixed the old homozygous copulations might be misleading. Copulations do not generally occur in colonies on agar; broth seems much better.

Only a fraction of the single ascospore cultures produces stable haplophases. We isolated stable haplophase cultures from other strains of yeast (*L*, *FLD*, 800 and 812) and paired these with each other in all combinations. The resulting diplophase was transferred to gypsum and the culture inspected for spores with the results shown in table 1. This test indicates that the a/*a* allelism is modified by other factors. Culture 28 copulates with all other forms and produces what appeared to be viable spores with both a and *a* types. On the other hand, several of the stable haplophase cultures were unable to copulate with any of the other strains against which they were tested. This was especially true with cultures isolated from the *FLD* strain whose pedigree has been published elsewhere (Lindegren and Lindegren, "*D*" family pedigree, '43b). These facts indicate that other factors superimposed on the a/*a* alleles may produce an excessively fertile or a sterile phenotype.

COMPARISON OF THE MECHANISM ASSURING CROSS-FERTILIZATION IN YEASTS WITH THAT IN OTHER ORGANISMS

Cross-fertilization in yeasts is necessary to assure the production of viable ascospores. A principal allelic pair of genes determines the copulating type to

TABLE I

RESULTS OF PAIRING HAPLOPHASE CULTURES FROM VARIOUS SOURCES IN ALL POSSIBLE COMBINATIONS.

	M 2	L 17	812 25	M 4	L 16	L 38	800 28
M 2		—	—	+S	+S	+	+S
L 17			+N	+N	+S	+S	+S
812 25				+S	+N	+	+S
M 4					—	—	+
L 16						—	+N
L 38							+S
800 28							

which a haplophase culture belongs. The situation in yeasts appears to be different from that in other living organisms, and the present discussion points out the characteristics of the various mechanisms for insuring cross-fertilization.

1. *Self-sterility alleles.*—Most hermaphroditic flowering plants are self-sterile due to a genetic mechanism which prevents pollen shed by the flower from growing down the styles of the parent plant. A mechanism that is probably fundamentally similar prevents the sperms of an individual hermaphroditic sea squirt, *Ciona*, from fertilizing eggs produced by the ovaries of the same individual.

2. *Sexual Dimorphism.*—In higher animals and some plants sexual dimorphism insures cross-fertilization. The genetic mechanism simply operates to reduce the probability of intersexes or hermaphrodites occurring.

3. *Plus-Minus Factors.*—This mechanism in *Rhizopus* is not a sexual mechanism because no unmistakeable sex organs are involved and therefore it cannot be called a self-sterility mechanism. It is more precise to consider it a special case in which a single pair of alleles controls copulation.

4. *Neurospora.*—We formerly called the alleles in *Neurospora* plus-minus factors, but later work has shown that they resemble self-sterility alleles more

closely than the factors found in *Rhizopus*. Both plus and minus thalli contain both male and female sex organs and self-fertilization is prevented. However, since the plus and minus thalli are both haploid and the zygote is invariably heterozygous for the same pair of plus-minus alleles this mechanism differs considerably from the standard self-sterility mechanism found in flowering plants in which a large series of multiple alleles exists and a great variety of heterozygotes abound.

5. *Hymenomycetes.*—The hymenomycete mechanism resembles the plus-minus *Rhizopus* mechanism rather closely since no obvious sex organs exist in these forms. It differs in the facts that in many hymenomycetes two loci are involved and that a multiple series of alleles at these loci further complicates the picture.

6. *Mating types.*—The mechanism which assures cross-fertilization in the single-celled diploid *Paramecium* resembles the plus-minus mechanism found in fungi since no sex organs are present, but the heredity seems to be more complex. The fact that the copulating cells are diploid is a still further difference from the most closely comparable fungal mechanism.

7. *Yeast.*—The mechanism in yeast is clearly different from the preceding. Our experiments indicate that monohybrid allelism modified by other factors controls copulation and we have given the symbol a/*a* to the principal allelic pair. However, the zygote is so much more vigorous than either parent that the diploid state produced by copulation has the character of hybrid vigor. In addition to insuring cross-copulation, heterozygosis for these factors results in a great increase in vigor, especially with regard to cell size and spore viability. The diminished vigor of the haplophase assures eventual supremacy of the hybrid in competition. Yeasts are quite different from most fungi since they propagate both as haploid and diploid cells and, in nature, balance, selection, and competition occur between these states. When the spores germinate in the spring the first growth may be haploid with one haplophase type competing with another until either legitimate or illegitimate copulation occurs, producing an even more complex state of competition. In the late fall sporulation occurs. Only the legitimate diploids produce viable spores and the cycle begins in the following year after these spores have germinated.

SACCHAROMYCES, TORULA, AND ZYGOSACCHAROMYCES

The diagram (text-fig. 2), showing the life cycle of *Saccharomyces cerevisiae* and including *Torula* and *Zygosaccharomyces* as phases of the cycle, has developed from the study of single-ascospore cultures. Stable haplophase cultures derived from S. *cerevisiae* fall into three classes: (1) those which do not copulate with any other strain, (2) those which copulate with all other copulating strains, and (3) those which copulate with their allelic partners only. The first type is a round-celled *Torula*, and Šatava ('34) pointed out that this genus is invalid because all *Torulae* have probably arisen from *Saccharomyces*. Illegitimate copulations occur in most old broth cultures of classes 2 and 3. Although the capacity of these illegitimate

homozygotes to produce spores is quite variable some of the cultures sporulate rather abundantly. They would be classified as *Zygosaccharomyces*. The spores in *Zygosaccharomyces* are probably inviable, but there are few, if any, records on the viability of spores in this genus. *Zygosaccharomyces* colonies are nearly always the rough type (Lochhead and Farrell, '31), another indication supporting the view that this genus contains single ascospore cultures of *Saccharomyces*. Conditions of copulation and sporulation seem in general to parallel each other, and illegitimate homozygotes which sporulated immediately on copulation would give the classical *Zygosaccharomyces* picture.

Dvornik ('38) recently studied spore formation in 50 strains of *Saccharomyces apiculatus*. They all formed one-spored asci. The vegetative cells bud characteristically with what appear to be abortive copulation tubes and resemble very closely some of the haplophase single ascospore cultures which we regularly obtain from *Saccharomyces cerevisiae*. The genus *Nadsonia* produces a peculiar type of polar budding similar to the "rosettes" or "figure 8" conformations found in single ascospore cultures. This genus may also be a peculiar type of single ascospore culture. These considerations indicate the inadvisability of giving generic or specific rank to peculiar types of yeasts incapable of producing asci containing four viable spores.

SUMMARY

Haplophase ascospore cultures derived from 4-spored asci of *Saccharomyces cerevisiae*, when paired with their complementary types, copulate to reproduce the original form.

Haplophase cultures originating from single ascospores of *Saccharomyces* resemble *Torulae* or *Zygosaccharomyces*. They are generally "rougher" and weaker than the diploid parent. The basis for the different rough characters is the inheritance of different types of budding and cell association. Variation of the haplophase is much greater than of the diplophase and the original segregant can be differentiated from the secondary mutants by serial plating.

The factors differentiating the copulating types seem to differ fundamentally from factors insuring cross-fertilization in other forms and were designated the a/α alleles.

Torula ("Torulopsis") and *Zygosaccharomyces* are probably invalid genera and merely represent phases in the life cycle of *Saccharomyces*.

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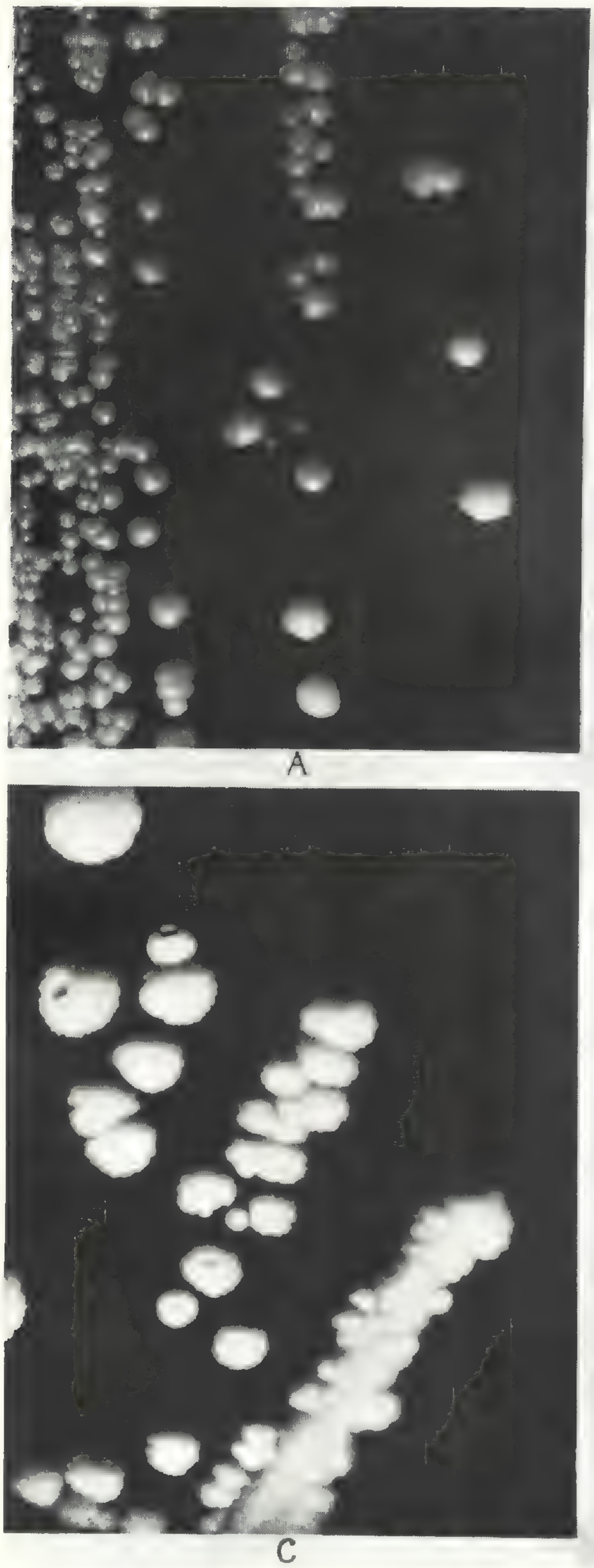
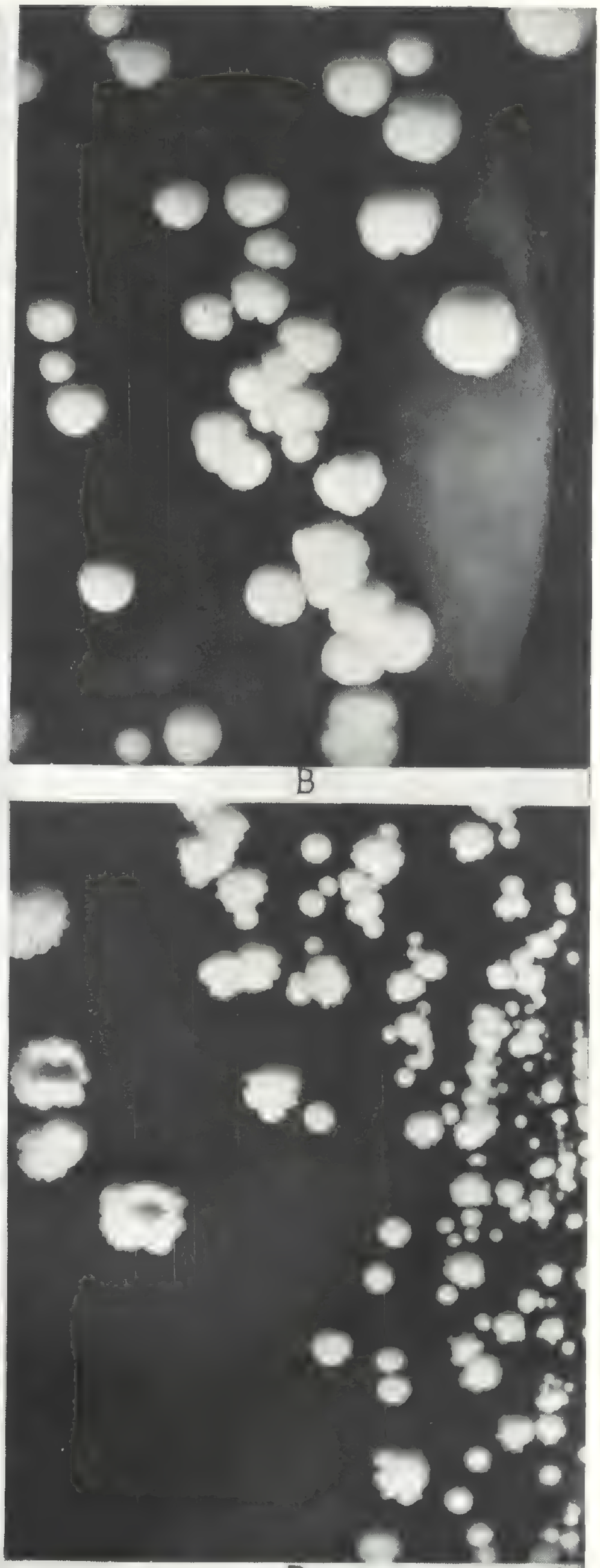
Explanation of Plate

PLATE 15

Saccharomyces cerevisiae

Colonies grown from the four ascospores dissected from a single ascus of the M strain.





LINDEGREN & LINDEGREN—SACCHAROMYCES CEREVISIAE

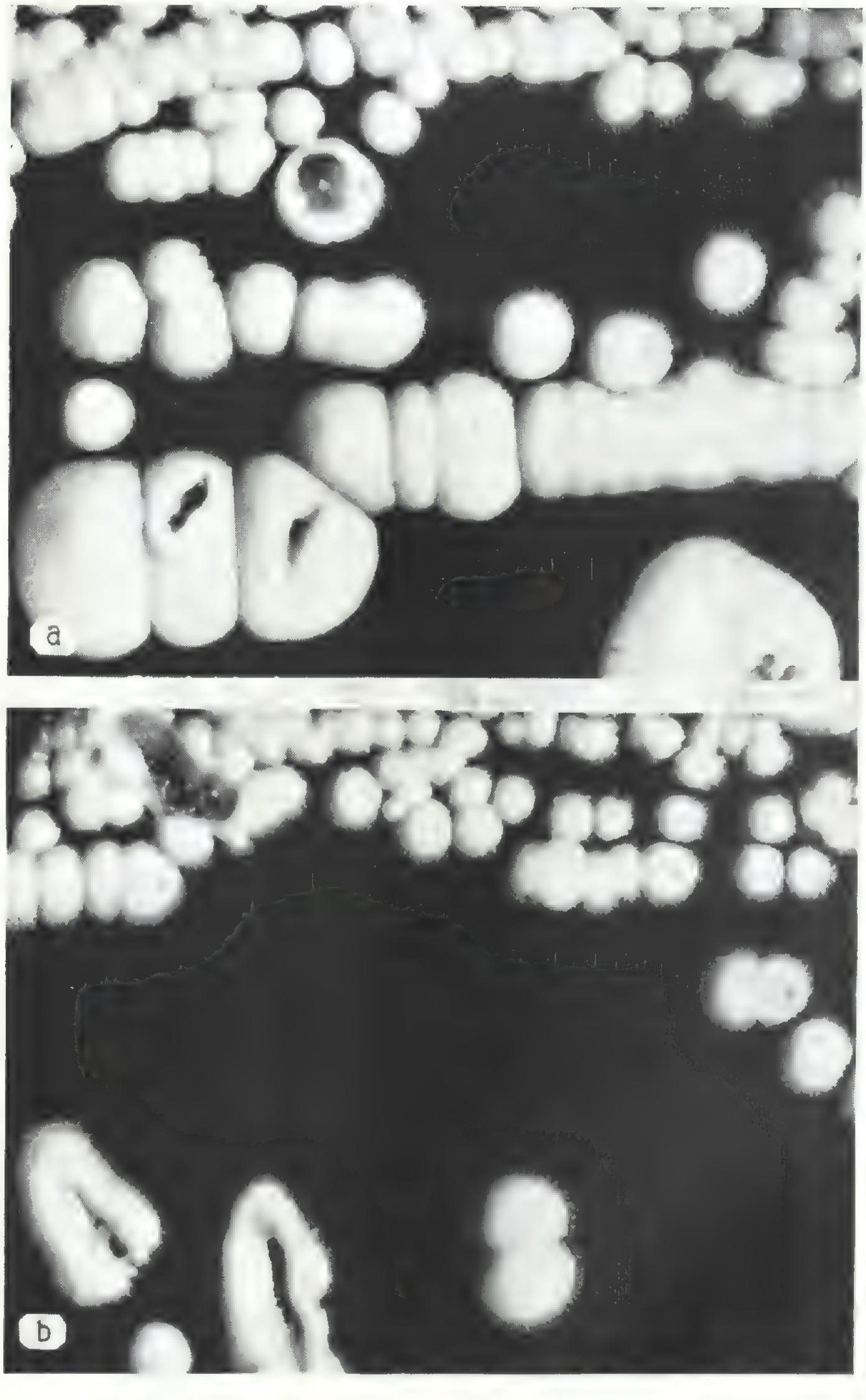
Explanation of Plate

PLATE 16

Saccharomyces cerevisiae

Fig. a. Diploid colonies produced by the self-fertilization of an intact 4-spored ascus from the same culture tube as the ascus from which spores *A*, *B*, *C*, and *D* of pl. 15 were obtained. When an intact 4-spored ascus is isolated and permitted to germinate, copulations usually occur before growth has progressed very far and the diploid cells soon outgrow the haploid ones. Diploid colonies are uniform and smooth in contrast to the haplophase colonies, which are generally rough and variable. These diploid cultures produce viable 4-spored asci while the cultures shown in pl. 15 do not.

Fig. b. A second culture obtained by self-fertilization of a 4-spored ascus in the same manner. Some cultures produced in this way are rough and cannot produce 4-spored asci. This is presumably because only a single spore in the ascus was viable.



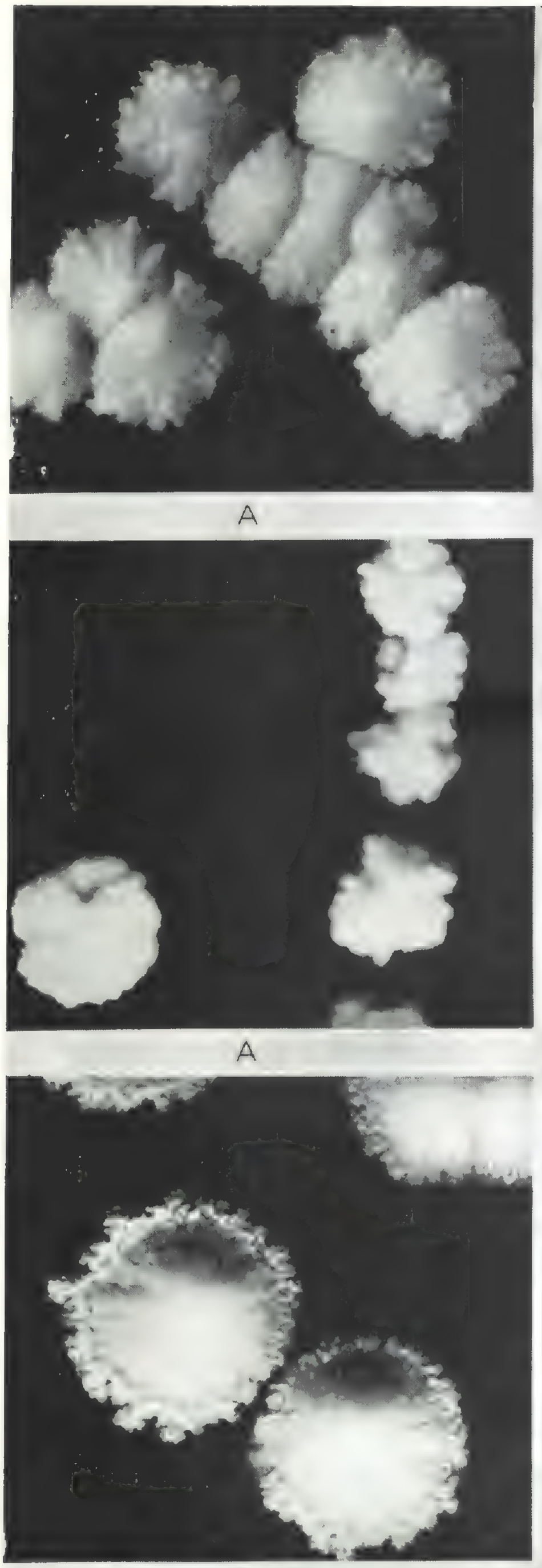
LINDEGREN & LINDEGREN—SACCHAROMYCES CEREVISIAE

EXPLANATION OF PLATE

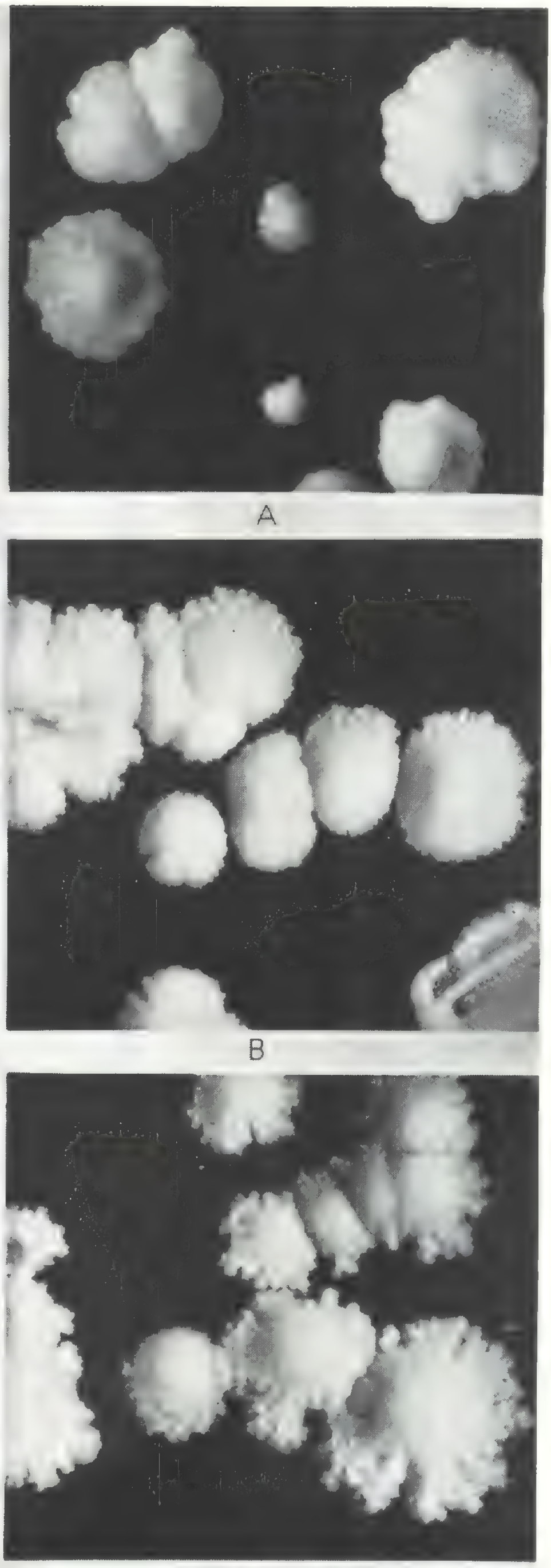
PLATE 17

Saccharomyces cerevisiae

Haplophase subcultures of the cultures shown in pl. 15 are reisolated six months after the original cultures had been grown from ascospores.



A



A

A

B

C

D

LINDEGREN & LINDEGREN—SACCHAROMYCES CEREVISIAE

A VARIETY OF MAIZE FROM THE RIO LOA

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In our collections of maize, two ears procured by Carl and Jonathan Sauer at a remote oasis on the Rio Loa in northern Chile are of particular interest. They are in various ways more like prehistoric Peruvian maize than anything else in our collections. In several peculiar characters they also bear a close resemblance to certain Oriental varieties. These facts reopen the entire problem of pre-Columbian contacts between the New World and the Orient. The actual facts concerning these remarkable plants are summarized below; the questions which they raise are so vast and are in such different fields that even a preliminary discussion of their significance must be a cooperative, long-time program.

Jonathan Sauer has contributed the following note concerning the locality where the ears were collected:

"Chiuchiu is an Indian village on the Rio Loa above Calama. It is an irrigated oasis within the approximately rainless desert, the green valley land surrounded by completely barren plains. The altitude is slightly over 2500 meters, and the latitude 22° South. The site is subject to occasional cold winds blowing across near-by snowy mountains. We saw three kinds of maize at the village, the most largely produced being a yellow flint which is also popped. Flint and pop corns are not clearly differentiated in use, name, or perhaps even as to philogeny. They are commonly lumped by the native name *morocho*. In addition, there was a markedly smaller white *morocho* preferred for popping purposes. This is the sample used by Dr. Anderson in the present study. The third local corn was a white, plump-grained flour corn."

The original collection by Sauer and Sauer consisted of two ears which were essentially similar. One of them is illustrated, approximately natural size, in pl. 18. Measurements on the ear and on the plants grown from the seed are presented in table 1. Diagrams of internode patterns are shown in fig. 1. The ears were small,

TABLE I

MEASUREMENTS OF MAIZE FROM THE RIO LOA

Ear No.	Midcob width	Midear width	Row No.	Shank diam.	Cob color	Leaf width	Leaf length	Plant height	Kernel width
1	1.5 cm.	2.8 cm.	20	6 mm.	red	10 cm.	60 cm.	11 dm.	4 mm.
2	1.1 cm.	2.6 cm.	16	5 mm.	white	8 cm.	60 cm.	9 dm.	4 mm.

with slender cobs, the latter being less indurated than is common in modern maize. They were rounded and tapered toward both ends. The small kernels were so irregularly set that the rows (which are apparently arranged spirally) were difficult to count. As in many South American varieties, the kernels were so lightly attached to the cob that they fell off when the cob was handled. Each of the ears was segregating for endosperm color and showed some white and some light yellow grains. Ear No. 1 had a red cob and No. 2 a white one. Cross-pollinations with tester stocks supplied by E. G. Anderson indicated that they were of the genetic

composition *rrccPrPr*. The kernels were flinty and were rounded at the apex.

Seed from cob No. 1 was planted in early May and matured its tassels in 2½ months. Seed from cob No. 2 was planted in late July, and the plants shed their first pollen in exactly 60 days. This was a much shorter season than any of our other collections from South America. Internode diagrams of five plants are presented in fig. 1. As compared with our other collections, the plants from the Rio Loa are outstanding by the constancy of their internode length and the shortness of the internode below the tassel. On the one hand, they did not have the series of gradually increasing short internodes at the base of the plant; on the other, the central internodes were shorter and less variable.

The leaves were short, wide, and pointed, and were unusual in color and texture. They were very dark green and seemed thicker, smoother, and more flexible to the touch than do ordinary maize leaves. There was no pronounced channel in the middle of the leaves as in North American maize, and the mid-rib scarcely protruded from the under surface of the leaf.

The anthocyanin coloration of the sheath was similar to that of our high-altitude collections from Peru and Ecuador but was more extreme. It was not noticeable in young plants but developed rapidly just before the tassels appeared, starting on the back of each sheath and spreading out from this center. It was a dark brownish red and was deposited between the veins of the sheath. When fully developed it gave the appearance of dark green veins running across a purple-brown background. The color was highly and evenly developed on the back of the sheath and faded out towards the margin so that there was almost no color in the marginal centimeter. Dr. L. J. Stadler informs me that both of these features (avoidance of the margin and interveinal color deposition) are usually indicative of a "strong" allele of *B* and a weak allele of *R*.

In our cultures the plants bore from two to four ears with long narrow blade-like appendages on the outer husks. The development of color in the husks was similar to that in the leaves.

As the plants began to tassel one of their most striking features was the one-sided arrangement of about half of them. On these plants the blades of the upper two or three leaves were displaced so that they were immediately above one another and formed a sort of spathe for the tassel (the male inflorescence) when it first appeared. This peculiar arrangement was first described by Collins ('09) as occurring in some of the Waxy maize from China and Burma and has been supposed to be unique in these Oriental varieties. It is well illustrated in Collins' plate in which the plants look very much like some of ours except that ours have broader leaves. As the plants developed they gradually grew out of this peculiar position, and at maturity almost no indication of the one-sided arrangement was left. So far as we know it has not previously been reported for any New World varieties of maize. However, in our own cultures an approach to this condition is sometimes seen in the peculiar high-altitude varieties from Peru and Ecuador.

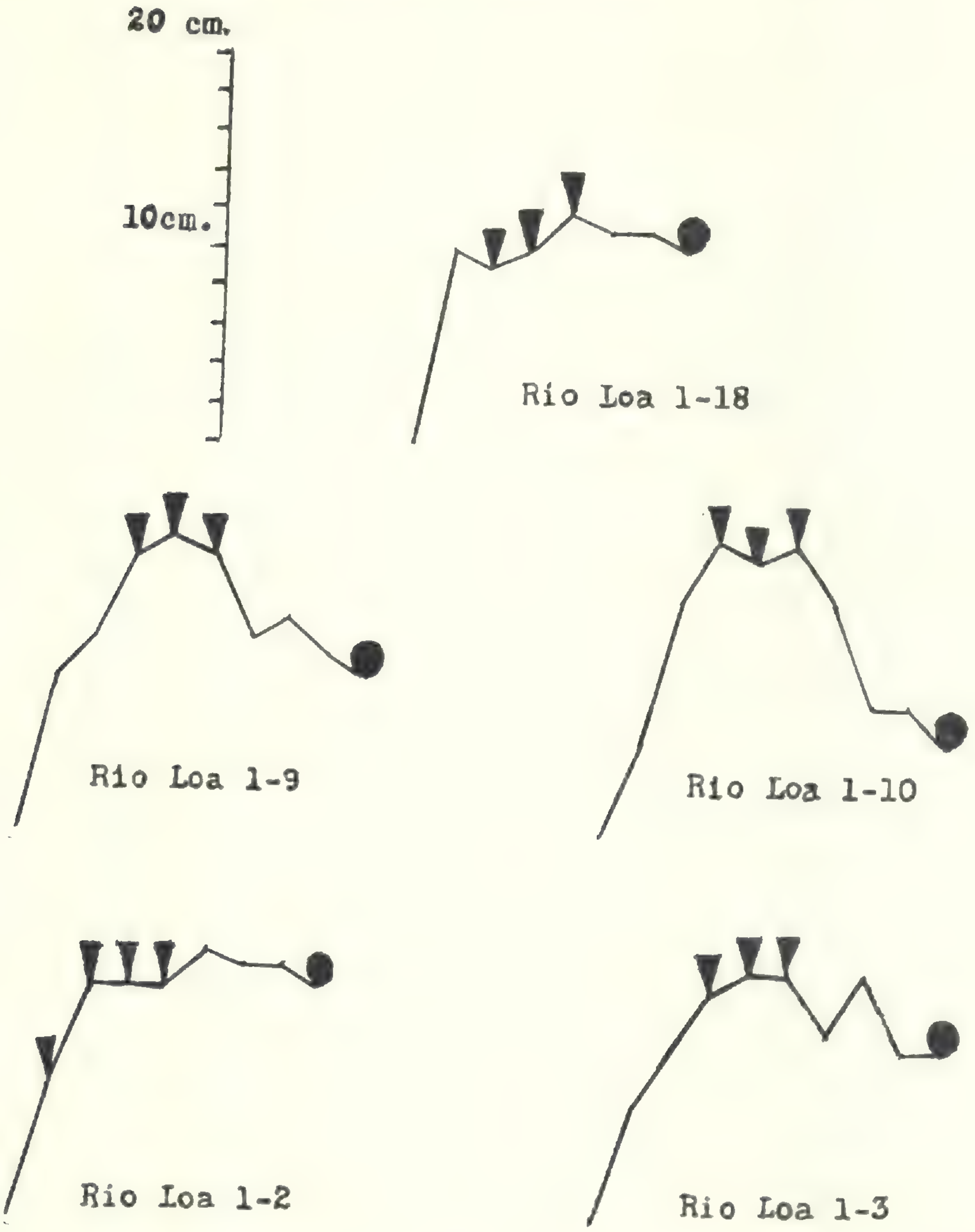

Fig. 1. Internode diagrams of five plants of Rio Loa–1 grown in the experimental fields of the California Institute of Technology at Arcadia, Calif. In each figure the vertical scale represents height in centimeters; the horizontal scale, successive internodes; triangles, ears; and circles, tassels.

The tassels were a dark green throughout, varying from plant to plant in the extent to which a dull dark red was deposited on the glumes, all of which had a bar of dark red at the base. The glumes were small, the upper spikelet was pedicelled, though the length of the pedicel was not as long as in many South American varieties. Several of the plants were sterile, and whether this was due to the change in environment or a segregating gene we have as yet no means of knowing. The plants were segregating for anther and silk color. In some both silk and anthers were pure green; in the remainder they were dilute sun-red.

Pollen mother cells were examined cytologically by means of aceto-carmine smears. They were knobless at pachytene with the exception of chromosome No. 6, which showed a small knob adjacent to the organizing body.

Comparisons with Other Varieties.—The Rio Loa maize as described above was more or less like much of the high-altitude maize of South America in its broad leaves, its low knob number, its tassel characters, and its rounded ears with irregular rows and easily detached kernels. For comparison we had living plants from Peru and Ecuador and an unpublished summary of Bolivian maize prepared by Dr. Hugh C. Cutler. In other characters it is more unique and bears a close resemblance only to certain Oriental varieties and to early prehistoric ears from South America. Contrary to general belief, maize is very extensively grown in certain parts of the Oriental tropics (Heyne, '27; Van Gorkom, '13; Collins, '09) as, for instance, Java, Madura, Burma, and South China. For exact comparisons there are available only the general statements in the literature, Collins' excellent detailed report on a more or less mixed collection from China, and the inbred descendants of this original importation. Seeds of the latter were kindly supplied by J. H. Kempton, then of the U. S. Department of Agriculture. From this material we know that the maize from the Rio Loa resembles the Oriental varieties in its small cob, small seeds, early season, dark green leaves, and in its peculiar habit of forming a spathe over the developing tassel.

Of the prehistoric material, only the ears are available for comparison since they are hundreds if not thousands of years old, and since maize seeds never retain their viability more than a decade or two at the most. The prehistoric material was made available through the courtesy of Professor Alfred Kroeber and the Museum of Anthropology of the University of California. There was also a single collection made by Professor Carl Sauer which was of particular interest since it was obtained from an ancient graveyard only a short distance from the modern maize field in which he found the maize described above.

Distinctive ears of the prehistoric collections are illustrated in pl. 18. It will be seen that the early Nazca material agrees with the ears from the Rio Loa in being small-grained, small-cobbed, irregular-rowed and appressed. All of these ears are associated with the culture designated by archaeologists as "early Nazca." Not until later cultures did larger grains and straighter rows make their appearance (pl. 18, fig. 5). While the ears from the Rio Loa are not identical with the prehistoric collections, they resemble them much more closely than do any of the other ears in our collection, or any that we have seen.

Discussion.—While it has long been known in the Occident that maize was of considerable antiquity in the Orient (see Laufer for a complete discussion) the published evidence could lead only to the conclusion that *Zea Mays* originated in the New World and that it was post-Columbian in the Orient (Mangelsdorf and Reeves, '39). When, however, we no longer content ourselves with cataloguing any kind of maize merely as *Zea Mays* (Anderson and Cutler, '42), it becomes

necessary to re-examine this evidence more precisely. The facts reported above demonstrate that a peculiar strain of maize from a remote and isolated Chilean oasis is, on the one hand, very similar to early prehistoric maize of that same region and, on the other, to certain Oriental varieties. This suggests very strongly a pre-Columbian transfer of maize between the Orient and western South America. From the evidence at present available we have no means of knowing whether it might have originated in the Orient and then spread to South America, there to continue its development as outlined by Mangelsdorf and Reeves ('39) or whether it may have originated in South America and spread in the other direction. All that we know for certain is that a primitive type of maize from western South America is more like Oriental maize in several of its distinctive characteristics than are any of the more commonly cultivated races of that polymorphic species.

It is imperative therefore that the entire problem be re-examined in the light of this evidence and that in particular the small-grained, small-cobbed "pearl Maize" of the Orient be exhaustively compared with living and prehistoric American varieties. Not until extensive collections have been made in Upper India, Burma, and the Dutch East Indies will we be in a position to discuss the question intelligently. It may be pointed out in passing that this region is one of the chief centers of diversity of the Maydeae (Henrard, '31), the group of grasses to which *Zea* belongs. Furthermore, if we follow Mangelsdorf and Reeves ('39) in excepting the genus *Euchlaena* as a comparatively recent artifact, all the Oriental Maydeae agree with *Zea* in having chromosome numbers based on 5 or 10 while the New World Maydeae have a base number of 18.

Summary.—A variety of maize collected from a remote and isolated agricultural community in northern Chile is very similar to the maize of the prehistoric Nazca culture of that same area and adjacent Peru. If not identical with Nazca maize it resembles it more closely than do other varieties in our collections of North and South American maize. In a number of distinctive and peculiar characters it is also more like certain Oriental varieties than anything else in our collections. These facts reopen the entire question of Oriental vs. Occidental origins of *Zea Mays*. Before the problem can be intelligently discussed, definitive collections of maize must be assembled from southern China, Burma, northern India, and the Dutch East Indies.

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Explanation of Plate

PLATE 18

Figs. 1–5. Rio Loa maize compared with prehistoric South American ears. All approximately natural size. Photographs courtesy of the Museum of Anthropology of the University of California.

Fig. 1. Original ear (No. 1) collected by Sauer and Sauer.

Figs. 2–4. Three ears (No. 171037) collected at Nazca, Peru, by Professor A. L. Kroeber.

Fig. 5. Prehistoric ear from a later period (Late Inca) to show differences. No. 168804 (courtesy of the Field Museum) collected at Lima Valley (Armatambo), Peru, by Professor A. L. Kroeber. Note the larger cob, larger kernels, and straighter rows.

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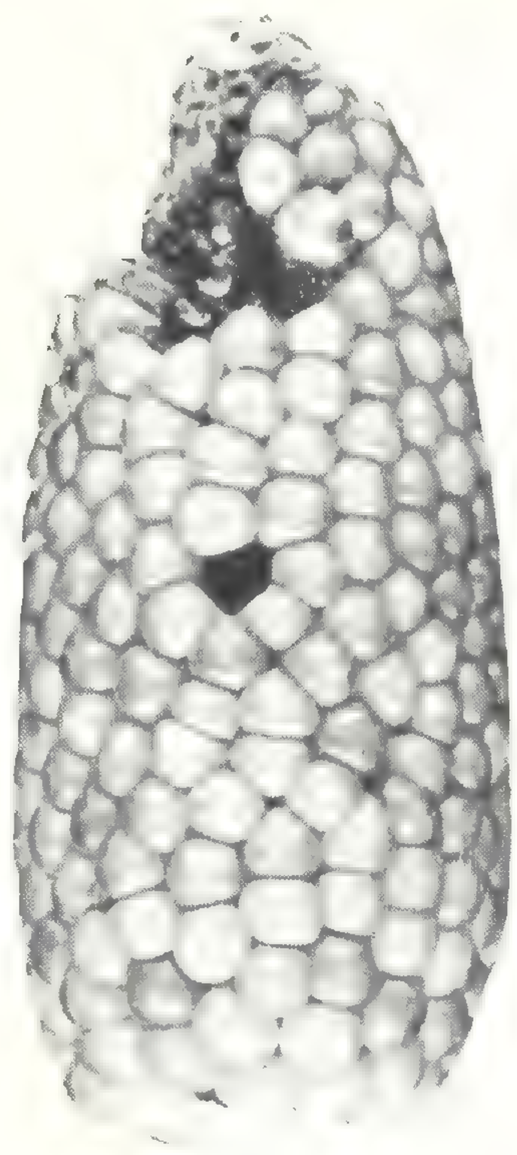
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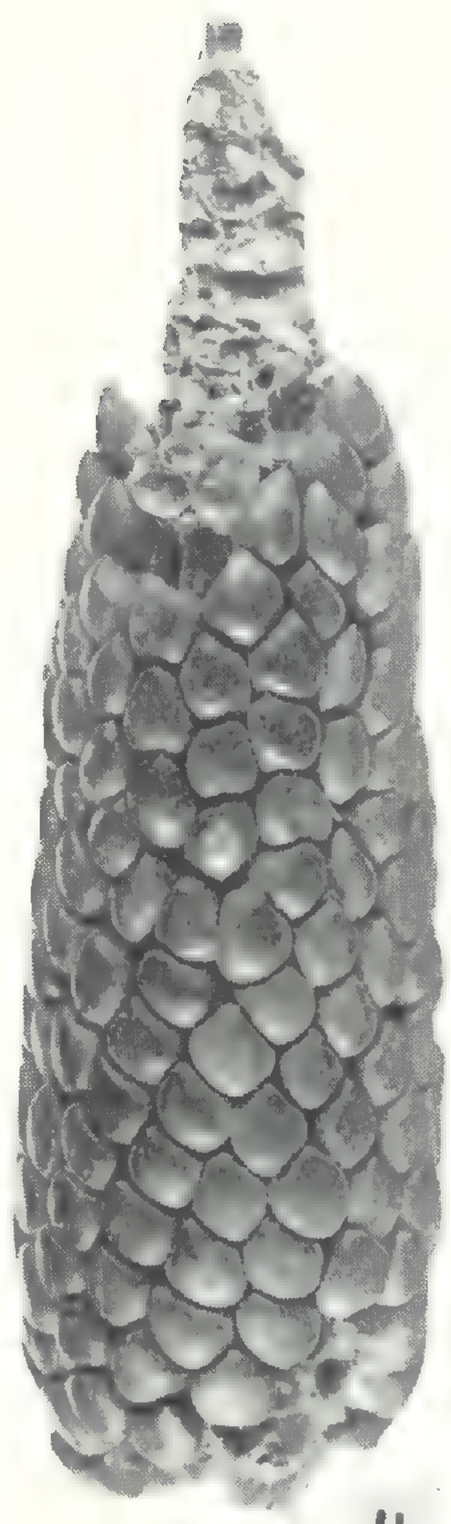
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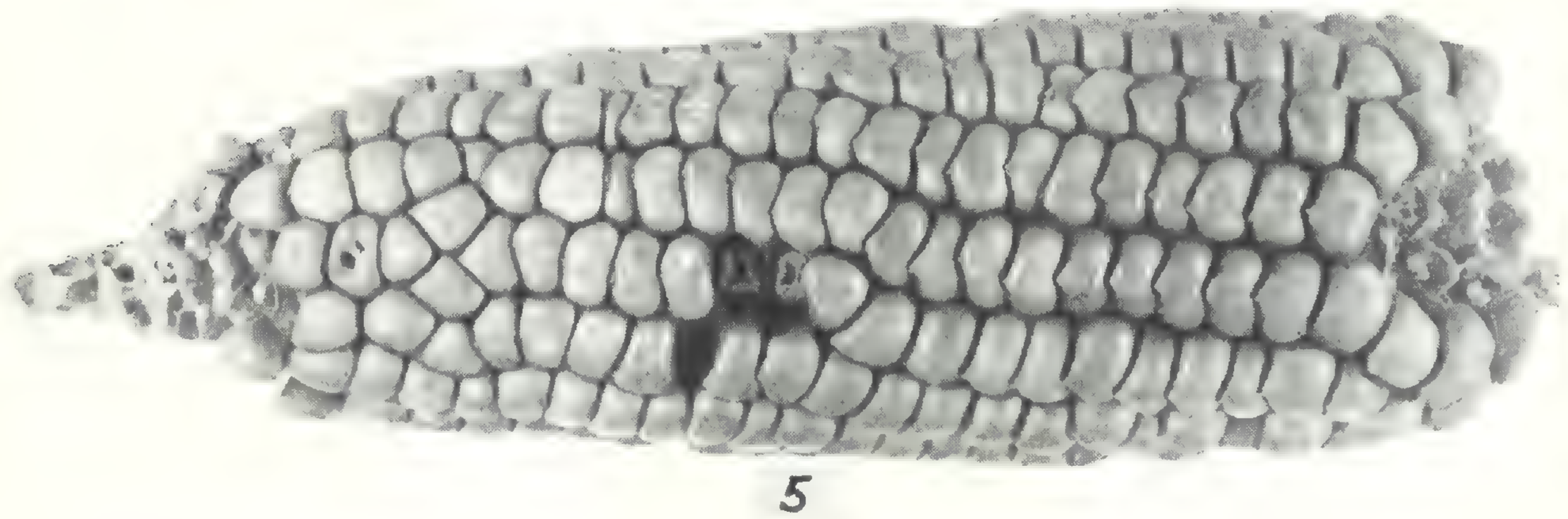
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GENERAL INDEX TO VOLUME XXX

New scientific names of plants and the final members of new combinations are printed in **bold-face** type; synonyms and page numbers having reference to figures and plates, in *italics;* and previously published names and all other matter, in ordinary type.[1]

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